FISHERY MANAGEMENT INVESTIGATIONS

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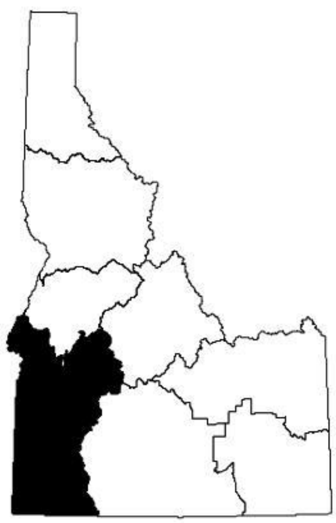

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LAKES AND RESERVOIRS INVESTIGATIONS

LUCKY PEAK & ARROWROCK RESERVOIRS

ABSTRACT

Lucky Peak and Arrowrock reservoirs are water storage reservoirs near Boise, ID. Water operations are cooperatively managed by the US Army Corps of Engineers (USACE) and the Bureau of Reclamation (BOR), recreation is managed by BOR and Idaho State Parks (ISP), and fish and wildlife are managed primarily by Idaho Department of Fish & Game (IDFG, Department). Lucky Peak and Arrowrock reservoirs provide diverse recreational opportunities, including recreational watercraft use and myriad angling opportunities. The kokanee *Oncorhynchus nerka* fisheries at Arrowrock and Lucky Peak reservoirs continue to be two of the most popular in the state and have experienced a sizeable increase in angler interest during the last decade. In 2019, IDFG conducted a series of evaluations on fisheries within Lucky Peak and Arrowrock reservoirs including creel, gillnet, and standardized lowland lake surveys. Based on these evaluations, kokanee angler catch rates were low, as were fall gillnet catch per unit efforts (CPUE). Lowland lake surveys indicated high CPUE of non-game fishes (Northern Pikeminnow *Ptychocheilus oregonensis* and sucker spp *Catostomus spp.*). With regard to kokanee management, ongoing investigations evaluating relationships between stocking or environmental metrics and angler CPUE or growth are an important component of fisheries management. Additionally, fall gillnet surveys will continue to provide insight into the following year's kokanee fishery. Due to high angler interest and variability in these kokanee fisheries, continued angler effort and population monitoring are important and will continue into the future.

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INTRODUCTION

Arrowrock and Lucky Peak reservoirs are two popular kokanee fisheries in Idaho and have experienced a sizeable increase in angler interest since annual kokanee stocking began in the late 1990s. Stocking is required to support both fisheries since limited wild recruitment and entrainment from upstream reservoirs only supplements overall kokanee abundance. Annual variation in angler CPUE at these reservoirs has led IDFG to examine if the cause of this variability may be attributed to size at stocking, timing of stocking, stocking density, or hydrologic conditions. Prior to 2012, IDFG had anecdotal information on which years had produced good fishing, but no actual catch or CPUE data. Due to the growing popularity of kokanee fishing with anglers, IDFG recognizes the need to monitor these fisheries more quantitatively. Therefore, our objectives for this work were to continue to contribute annual biotic and abiotic data to a suite of correlations to better assess current and future kokanee population trends. These correlations will allow IDFG to more clearly define kokanee management goals for angler CPUE and size-at-maturity and obtain better understanding of how reservoir management, spawning conditions, and stocking affect survival and growth of individual kokanee year classes.

Kokanee life history differs considerably from other inland salmonids resulting in different monitoring and management strategies for these populations. Kokanee are semelparous salmon that feed and grow in lakes or reservoirs for two to four years, then spawn in tributaries or along shorelines during fall before subsequently dying. Eggs incubate in the streambed or shoreline gravels until hatching in late winter. Alevins remain in the gravel for several more weeks before emerging at night and migrating to the lake or reservoir. Fry commonly migrate directly to pelagic areas (Foerster 1968), but can spend time feeding in the littoral habitats, particularly in lakes or reservoirs with pronounced littoral regions (Burgner 1991; Gemperle 1998). Juvenile and adult kokanee are primarily found in pelagic zones of lakes and reservoirs, where they feed almost exclusively on zooplankton.

Managing kokanee fisheries is often challenging and complex because of the wide variation of population responses to system productivity, habitat, predation, and harvest (Paragamian 1995). These responses lead to changes in growth, fecundity, recruitment, age-at-maturity, and survival, which can also vary substantially between year classes. Many kokanee populations exhibit density-dependent growth and this central characteristic of kokanee biology is important for fisheries managers to quantify and understand (Rieman and Myers 1992; Rieman and Maolie 1995; Grover 2006). Many kokanee populations in the western United States exhibit a strong negative relationship between population density and mean body size. Kokanee size and growth not only influence the number and size of fish available to anglers, but also angler's perception of the quality of the fishery (Martinez and Wiltzius 1995; Rieman and Maolie 1995). The tradeoff between density and growth is the key component to kokanee management in most waters and examples of efforts to influence density, growth, and survival are well documented (Rieman and Myers 1992; McGurk 1999)

During the last decade, kokanee have become increasingly popular with anglers in many areas of the western United States (Wydoski and Bennett 1981; McGurk 1999). This popularity is reflected in fishing magazine articles, social media, kokanee tournaments, and online forums dedicated to kokanee fishing. Information including stocking histories and regional management reports have become more accessible and easier to distribute to anglers through the World Wide Web. IDFG has observed a notable increase in angler interest in the management of kokanee fisheries across the state, particularly inquiries into stocking rates (Cassinelli 2019, pers. comm.).

STUDY AREA

Arrowrock Reservoir is a 1,255-ha dendritic impoundment located approximately 32 km northeast of Boise in the Boise River drainage (Figure 1). It is a 29 km-long, narrow canyon reservoir that impounds two major tributaries; the MFBR and SFBR. Arrowrock Dam is located directly upstream of Lucky Peak Reservoir and is operated by the U.S. Bureau of Reclamation (BOR). Arrowrock Reservoir is managed primarily for flood control and irrigation. In a typical year, the reservoir is maintained at approximately 60-80% storage capacity during winter months and generally reaches 100% capacity by May. Beginning in June, the reservoir is drafted, and by August usually reaches 10-35% of capacity (defacto minimum of 50,000 af), after which the reservoir slowly refills during the fall and winter. IDFG began annual stocking of fingerling kokanee at Arrowrock Reservoir in 2009. Since 2015, the default stocking request for Arrowrock Reservoir has been 100,000 fish or 80 fish/ha stocked in early June (Table 1). This is a two-fold increase in stocking numbers compared to 2012-14.

Lucky Peak Reservoir is a 1,141-ha mesotrophic impoundment in the Boise River drainage, immediately downstream from Arrowrock Reservoir (Figure 2). It has a mean depth of 32.8 m, a total capacity of 3,615 x 10^5 m^3, and is managed by the U.S. Army Corps of Engineers to provide flood control, irrigation, power generation, recreation, and winter flows in the Boise River. In a typical water year, the reservoir is kept at 20-40% of storage capacity during winter and reaches 100% capacity by early summer; subsequently, Arrowrock Reservoir and Anderson Ranch Reservoir releases are utilized to keep Lucky Peak Reservoir near full pool for recreation during the summer months. After Labor Day, Arrowrock begins refilling while Lucky Peak is then drafted to lower pool elevations. The default kokanee stocking request for Lucky Peak Reservoir is 250,000 fingerlings or 217 fish/ha in early June (Table 1). In 2019, kokanee fingerlings were not needed in other waters, and as such, 480,000 kokanee fingerlings were stocked between Arrowrock and Lucky Peak reservoirs.

METHODS

Creel Survey

Check stations were used to collect creel data and index fisheries metrics. Kokanee creel information has been collected at Arrowrock and Lucky Peak reservoirs during the spring (late April – mid May) since 2012. Data was collected by surveying anglers at a check station, similar to a portion of the access-access survey design described by Pollock et al. (1994). This time period was selected as an appropriate month because anecdotal observations and angler reports suggest that this time period is one of the peak months for angling effort directed at kokanee. This time period also provides the opportunity to directly target and predominately interact with anglers, as recreational boaters do not become a significant portion of reservoir users until after Memorial Day. The focus of creel surveys was on kokanee and Rainbow Trout *Oncorhynchus mykiss,* but data was collected on all fish species encountered.

Creel clerks were stationed at a single site to intercept anglers as they exited the fisheries. The creel station was just east of state Highway 21 at Spring Shores Road turnoff (Figure 2). This creel station intercepted anglers from Spring Shores Marina, and Mack's Creek ramp, and Arrowrock Reservoir. Six dates, with three days of both weekday and weekend/holiday sampling units were randomly selected during spring 2013 and have been used in subsequent years. Two time periods were used: (1) an early time period (0900 - 1500 hours) and (2) a late time period (1500 - 2100 hours).

Data collection focused on completed fishing trips. Each interview or contact was assigned a unique interview number for that day, based on the numerical order by which anglers were contacted. Fishing license numbers, number of anglers in party, time fishing, target species, and the number of each species that were harvested or released were also recorded. Creel clerks were directed to obtain a CPUE per individual angler, although it may be difficult in trolling situations with multiple anglers. Fishing method, gear type, and total length (nearest mm to the tip of the non-pinched tail) and weight (g) of harvested fish were also recorded. Mean angler CPUE ($\widehat{R_2}$) was estimated using the ratio of means (ROM), where trip interviews were considered complete:

$$\widehat{R_2} = \frac{\frac{\sum_{i=1}^{n} c_i}{n}}{\frac{\sum_{i=1}^{n} e_i}{n}}$$

where $\hat{R}$ is the mean CPUE in fish/angler-hour, c_i is the number of fish caught during the trip, and e_i is the length of the trip in hours (equation $\widehat{R_2}$ from Pollock et al. 1994).

Finally, angler demographics based on license data collected during check station interviews were also analyzed. Angler age, years of license purchase, and address were summarized to gain a better understanding of the clientele using the spring fisheries at Lucky Peak and Arrowrock reservoirs.

Age -2 Kokanee CPUE and Size Evaluation

All fish sampled from the creel were measured and weighed. Kokanee length-frequency was used as an index of fish age based on a previous length-at-age model developed using otoliths. Relationships between both age-2 CPUE and length at age-2 and a suite of reservoir and stocking variables were analyzed by stepwise linear model selection framework. Variables analyzed included the number of fish stocked, stocking date, length-at-stocking, reservoir inflow and outflow at time of stocking, and reservoir capacity at time of stocking. Additionally, minimum and maximum storage, average storage (during both the lowest three months and lowest month), minimum and maximum inflow and outflow, mean inflow and outflow, and total inflow and outflow; all within the year of stocking and for the year following stocking were also analyzed. In previous years, fish caught in Lucky Peak Reservoir were analyzed with Lucky Peak variables. However, given the levels of entrainment of fish from Arrowrock Reservoir into Lucky Peak Reservoir described below, in 2019 we also analyzed fish caught in Lucky Peak Reservoir with Arrowrock Reservoir conditions. These correlations were limited to CPUE of age-2 fish since that age-class makes up the majority of the total catch and using a specific age allows correlation back to year-specific variables.

The model selection framework was developed by using a simple model (containing only an intercept term) as well as a complex model (containing all variables). Stepwise model selection was conducted by adding terms to the simple model, as well as subtracting terms from the complex model, with a theoretical optimal model generated with the lowest AIC value. Seven years classes of stocking (2010 – 2017) were analyzed. As additional years of creel data are collected, these correlations will be further analyzed.

Kokanee Abundance Gillnetting

Gillnet surveys were conducted on both Lucky Peak and Arrowrock reservoirs in fall 2019. Fall gillnet surveys were implemented as a means to evaluate the kokanee populations post-spawning. Sampling in the fall provides insight into the size of the age class that will spawn the following summer. In other words, age 1+ fish sampled in nets in the fall of 2019 will be the age 2 fish that make up the majority of the fishery in the spring and summer of 2020.

Gillnetting was conducted at Lucky Peak Reservoir on the evening of October 24th, 2019 and at Arrowrock Reservoir on October 25th, 2019. In each water, two gill nets were used to sample the entire kokanee layer (2 – 14 m below water surface) at three locations, for a total of six net-nights. Nets were set at dusk and retrieval started at dawn of the following day. Each gill net measured 48.8 m in length and 6.0 m in depth. Gill nets contained 16 panels, each measuring 3.0 m in length. Nets consisted of eight different mesh sizes (13, 19, 25, 38, 51, 64, 76, 102 mm; stretch measure) with two panels of each mesh size randomly positioned throughout the net. Each pair of gill nets were horizontally suspended with the two nets covering 2 to 14 m of water depth. Sampled fish were measured for total length (mm) and weighed (g) and otoliths were removed. Otoliths were processed to identify thermal marks applied to hatchery origin fish. These unique thermal marks allow for both identifying and aging of hatchery origin kokanee. Those fish lacking a thermal mark are presumed to be from natural production. Fish stocked into both reservoirs in 2017 were thermally marked while those stocked in 2018 were late-run kokanee and did not receive a thermal mark. Fish stocked in 2019 received a thermal mark from Cabinet Gorge Hatchery.

In an effort to quantify the amount of entrainment that occurs between Arrowrock and Lucky Peak reservoirs, 20% of the 100,000 kokanee (≈ 20,000) fingerlings stocked into Arrowrock Reservoir during 2017 – 2019 were adipose fin clipped. These fish were hand-clipped by Region 3 staff at the Mackay Fish Hatchery in April of each year. All fish captured in gill nets at both Lucky Peak and Arrowrock reservoirs were examined for a fin clip. At Lucky Peak Reservoir, recovered adipose-clipped fish were expanded by the year-specific clipping rate. Then, the unclipped (Lucky Peak Reservoir-origin) fish recovered by age were divided by the total number of Lucky Peak fingerlings stocked for that specific year class, to get a capture percentage. The expanded Arrowrock fish (from the same age-class) were then divided by this same percentage to generate an estimated total number of Arrowrock-stocked fish entrained in Lucky Peak Reservoir, by age.

Predator Gillnetting

Predatory fish populations in Lucky Peak Reservoir were sampled with gillnets during June 2019 following the stocking of hatchery kokanee fingerlings. Three 46-m long x 2-m deep monofilament gillnets were used and each had six panels composed of 19-, 25-, 32-, 38-, 51-, and 64-mm bar mesh. One gillnet, fished for one night, equaled one unit of gillnet effort, resulting in three total net nights of effort. Nets were set at sites near kokanee release locations. Two nets were set near Spring Shores, and one net was set near Macks Creek. Captured fish were identified to species, measured for total length (mm) and weighed (grams) using a digital scale. Stomach contents were examined; if contents appeared to be fish, the contents were estimated for total length (mm) and attempted to identify to species. Catch data were summarized as the number of fish caught per unit effort (CPUE).

Lowland Lake Surveys

Standardized lowland lake survey methods employed by IDFG are outlined IDFG Report Number 12-10 (Standard Fish Sampling Protocol for Lowland Lakes and Reservoirs in Idaho). Fish populations in Arrowrock Reservoir were sampled with standard IDFG lowland lake sampling gears during July 2019. Arrowrock Reservoir was divided into three sections, (main reservoir, SFBR arm, and MFBR arm; Figure 1). In total, eight trapnets, eight gillnet pairs, and one electrofishing unit (composed of three 1,200 second sub-samples) were used in Arrowrock Reservoir. Fish populations in Lucky Peak Reservoir were sampled with standard IDFG lowland lake sampling gears during July 2019. Lucky Peak Reservoir was divided into three sections (lower, middle, and upper sections; Figure 2). In total, nine trapnets, ten gillnet pairs, and one electrofishing unit (composed of three 1,200 second sub-samples) were used in Lucky Peak Reservoir.

RESULTS

Creel Survey

A total of 551 anglers were interviewed in spring 2019. Of the 551 anglers interviewed, 335 (60.7%) anglers fished Arrowrock Reservoir, and the remaining 216 (39.2%) anglers fished Lucky Peak Reservoir (Table 2). Average trip duration of anglers fishing at Arrowrock and Lucky Peak reservoirs were similar at 4.16 and 4.20 h, respectively. Across all anglers interviewed for both reservoirs, 170 (30.8%) reported their primary target species as kokanee. Of those, 112 (65.8%) fished Arrowrock Reservoir; 58 (34.1%) fished Lucky Peak Reservoir. Across all anglers interviewed for both reservoirs, 204 (37.0%) of creeled anglers reported their primary target species as trout. Of those, 131 (64.2%) fished Arrowrock Reservoir, while 68 (33.3%) fished Lucky Peak Reservoir. Five anglers did not report which water they were fishing. Of the 551 creeled anglers, 138 (25.0%) reported targeting any species, indicating they had no preference of fish species. Of that 138 anglers, 82 (59.4%) reported fishing Arrowrock Reservoir and 56 (40.6%) reported fishing Lucky Peak Reservoir. Finally, 2.9% of Arrowrock Reservoir anglers and 15.7% of Lucky Peak anglers targeted Smallmouth Bass (Figure 3).

Interviewed anglers fishing Arrowrock Reservoir caught few kokanee, with only 27 fish checked during the entire creel survey. Lucky Peak Reservoir had even fewer kokanee caught compared to previous years, with only one kokanee checked during the entire survey. On average, anglers targeting kokanee harvested 0.12 kokanee at Arrowrock Reservoir and 0 kokanee at Lucky Peak Reservoir, per trip. At Arrowrock Reservoir, approximately 81% of anglers targeting kokanee were unable to harvest a kokanee during that specific trip, and none of the anglers targeting kokanee at Lucky Peak Reservoir were successful (Figure 4). None of the interviewed kokanee anglers harvested their bag limit at either reservoir. At Arrowrock Reservoir, overall CPUE of kokanee was 0.03 fish/h, while CPUE at Lucky Peak Reservoir was 0.02 fish/h (Table 3). For anglers targeting kokanee, CPUE was somewhat higher at Arrowrock Reservoir (0.04 fish/h) however it was lower at Lucky Peak Reservoir (0.009 fish/h). Length of kokanee in the creel from Arrowrock Reservoir ranged from 270 to 510 mm (mean = 398 mm, SE = 49.5 mm; Figure 5). The lone Lucky Peak Reservoir kokanee was 370 mm.

Additionally, the percentage of anglers who were unable to harvest a kokanee at Lucky Peak Reservoir was 96%, an increase compared to 80% in 2018, 81% in 2017, 45% in 2016 and 82% in 2015). At Arrowrock Reservoir, the percentage of anglers that were unable to harvest a kokanee increased to 77% after being 29% in 2018, 92% in 2017, 82% in 2016 and 30% in 2015.

Interviewed anglers fishing Arrowrock Reservoir caught 41 Rainbow Trout, while anglers fishing Lucky Peak Reservoir caught 20 Rainbow Trout. Anglers targeting Rainbow Trout harvested an average of 0.2 Rainbow Trout at Arrowrock Reservoir and 0.01 Rainbow Trout at Lucky Peak Reservoir per trip. Approximately 91% and 98% of Rainbow Trout anglers were unsuccessful in harvesting Rainbow Trout at Arrowrock and Lucky Peak reservoirs, respectively. No interviewed anglers harvested a limit of Rainbow Trout (six fish) at Lucky Peak Reservoir, while only two interviewed anglers harvested a limit of Rainbow Trout at Arrowrock Reservoir (Figure 3). Rainbow Trout were caught at overall rates of 0.14 and 0.07 fish/h at Arrowrock and Lucky Peak reservoirs, respectively (Table 3). Angler CPUE for anglers specifically targeting Rainbow Trout was 0.11 fish/h at Arrowrock Reservoir and 0.07 fish/h at Lucky Peak Reservoir. Rainbow Trout at Arrowrock Reservoir ranged from 230 to 446 mm (mean = 333.6 mm, SD = 39.0 mm) while fish from Lucky Peak Reservoir ranged from 280 to 415 mm (mean = 335.6 mm, SD = 28.5 mm; Figure 6).

Anglers targeting kokanee had higher CPUE at Arrowrock than Lucky Peak, which was lower than 2018 for Arrowrock and similar to 2018 for Lucky Peak (Figure 8a). Angler effort (h) was similar at Arrowrock than Lucky Peak in 2019 (Figure 8b). The average total length of kokanee in the creel was higher in Arrowrock than Lucky Peak (Figure 8c). Anglers targeting Rainbow Trout had higher CPUE at Arrowrock than Lucky Peak, which was higher than 2018 for Arrowrock and similar to 2018 for Lucky Peak (Figure 9a). The index of angler effort (h) was higher at Arrowrock than Lucky Peak in 2019 (Figure 9b). The average total length of Rainbow Trout in the creel was similar at both reservoirs and there continues to be a slightly increasing trend in average length of Rainbow Trout caught in both reservoirs since 2014 (Figure 9c). This trend corresponds with the change in catchable stocking size from a 10-inch average to a 12-inch average. Historically, Rainbow Trout anglers represented between 25% and 42% of all anglers. The proportion of Rainbow Trout anglers in 2019 was 39%, similar to years past.

Anglers targeting kokanee in Lucky Peak and Arrowrock reservoirs averaged 45 years old and ranged from 14 to 80 years old (excluding anglers under 14). The majority were male (78%) and Idaho residents (99%). Of the Idaho Residents, the majority (83%) reside in either Ada or Canyon counties. Anglers targeting Rainbow Trout in Lucky Peak and Arrowrock reservoirs averaged 44 years old and ranged from 13 to 80 (excluding anglers under 12). The majority were male (72%) and Idaho residents (96%). Of the Idaho residents, 86% reside in either Ada or Canyon counties. When we ignored target species and looked at all anglers, they were 78% male, 99% Idaho residents, and the average age was 43 (range 15 – 80 years old).

Age-2 Kokanee CPUE and Size Evaluation

A suite of 35 biotic and abiotic variables were used for the stepwise linear model selection framework. Models were generated to best estimate angler CPUE of age-2 kokanee and length of age-2 kokanee for both reservoirs, as well as the effect of the Arrowrock Reservoir kokanee fishery has on the Lucky Peak Reservoir kokanee fishery. The best model to estimate angler CPUE of age-2 kokanee in Lucky Peak and Arrowrock reservoirs, as well as comparisons of Arrowrock conditions to Lucky Peak angler CPUE was the intercept model. The best model to estimate kokanee length at age-2 for Lucky Peak Reservoir contained maximum storage during year 2, minimum inflow during year 2, angler effort, outflow at time of stocking, minimum outflow during year 2 and number stocked (AIC = 0.2). The next closest model (AIC = 29.77) included maximum storage during year 2, minimum inflow during year 2, angler effort, outflow at time of stocking and minimum outflow during year 2. The best model to estimate kokanee length at age-

2 for Arrowrock Reservoir contained angler effort, maximum outflow during year 1, minimum storage during year 2 and August storage during year 1 (AIC = 86.6). The next closest model (AIC = 96.8) contained angler effort and maximum outflow during year 1. The best model to estimate kokanee length at age-2 for Lucky Peak Reservoir fish based on Arrowrock Reservoir conditions contained maximum storage during year 2, maximum outflow during year 1, minimum storage during year 2, August and September storage during year 2 and maximum inflow during year 2 (AIC = 35.9). The next closest model (AIC = 40.5) contained maximum storage during year 2, maximum outflow during year 1, minimum storage during year 2, and August and September storage during year 2.

Kokanee Abundance Gillnetting

At Arrowrock Reservoir, gill nets captured a total of 11 kokanee. Other fish encountered included Rainbow Trout, Yellow Perch *Perca flavescens*, Largescale Sucker *Catostomus macrocheilus*, Mountain Whitefish *Prosopium williamsoni*, Redside Shiner *Richardsonius balteatus*, and Northern Pikeminnow *Ptychocheilus oregonensis*. Gill net CPUE for kokanee was 0.3 fish/net-night for age-0 fish, 0.5 fish/net night for age-1 and age-2 fish, and 0.16 fish/net night for age-3 and age-4 fish (Figure 7). Kokanee total length ranged from 114 to 460 mm (mean = 218 mm, SE = 32.5 mm*;* Figure 7). Of the 11 kokanee sampled, otoliths from 10 were successfully processed to determine fish age. We did not observe any thermally marked otoliths or adipose-clipped kokanee from Arrowrock in 2019.

At Lucky Peak Reservoir, gill nets captured a total of 48 kokanee. Other fish encountered included fall Chinook Salmon *Oncorhynchus tshawytscha*, Rainbow Trout, Yellow Perch, Bridgelip and Largescale Sucker, Chiselmouth, Redside Shiner, Smallmouth Bass and Northern Pikeminnow. Gill net CPUE for kokanee was 0.67 fish/net-night for age-0, 4 fish/net-night for age-1, 0.5 fish/net night for age-2 and 1.3 fish/net night for age-3 (Figure 7). Kokanee total length ranged from 123 to 345 mm (mean = 205 mm, SE = 11.1 mm; Figure 7). Of the 48 kokanee sampled, otoliths from 39 were successfully processed to estimate fish age. We did not observe any thermally marked kokanee otoliths. However, five kokanee had clipped adipose fins, indicating Arrowrock hatchery origin fish (Table 4).

Entrainment estimates of age-1 kokanee from Arrowrock Reservoir into Lucky Peak Reservoir continue to be highly variable. This is most likely due to the small number of kokanee that have been captured in Lucky Peak Reservoir from 2017 to 2019. In 2019, only five adipose clipped hatchery origin kokanee were sampled in gill nets, which was approximately 10% of the catch. This resulted in an estimated 57,313 fish entrained from Arrowrock to Lucky Peak.

Predator Gillnetting

At Lucky Peak Reservoir, a total of 82 fish were captured, including Northern Pikeminnow (*n* = 41), sucker spp. (*n* = 26), Rainbow Trout (*n* = 7), kokanee (*n* = 5), Chiselmouth (*n* = 1) and Yellow Perch (*n* = 1). Gillnet CPUE was 13.7 fish/net night for Northern Pikeminnow, 2.3 for Rainbow Trout, 1.7 for kokanee and 0.3 for Yellow Perch. From the stomach content analysis, only three fish were found with identifiable fish remains in their stomachs. All of the fish with identifiable stomach contents were kokanee, and they had an average of 1.7 kokanee fingerlings per stomach (*n* = 5*;* Table 5).

Lowland Lake Surveys

Arrowrock Reservoir

A total of 261 fish were captured during the standard lowland lake survey at Arrowrock Reservoir in 2019. Catch was predominately Northern Pikeminnow (*n* = 142) and Largescale Sucker (*n* = 66). Other species captured included Bridgelip Sucker, Bull Trout, kokanee, Mountain Whitefish, Rainbow Trout, Smallmouth Bass and Yellow Perch (Table 6). CPUE and WPUE indices for all species combined were 14.5 and 8.81 (Table 6). Gill nets were the most effective gear type with a total CPUE of 26.5 fish/unit effort, followed by electrofishing (CPUE = 13.0) and trap nets (CPUE = 2.88). Based on CPUE, Northern Pikeminnow made up 54% of the total catch, followed by Largescale Sucker (25%), and Smallmouth Bass (12%). All the other species collected contributed <5% of total catch (Table 6). Based on WPUE, the fish community consisted of Largescale Sucker (55%) and Northern Pikeminnow (37%). All the other species collected contributed <5% of total catch (Table 6).

Northern Pikeminnow were the most abundant fish sampled by CPUE (*n* = 142). They were captured with a total CPUE of 5.68 and a WPUE of 2.35 (Table 6). Gillnets yielded the highest CPUE (7.56) of the individual capture methods followed by trapnets (CPUE = 1.88) and electrofishing (CPUE = 0.35). Total length of Northern Pikeminnow ranged from 235 and 630 mm, however most (approximately 83%) of fish were between 330 and 390 mm (Figure 10).

Largescale Sucker were the most abundant fish sampled by WPUE (*n* = 66). They were captured with a total CPUE of 2.6 and a WPUE of 3.47 (Table 6). Gillnets yielded the highest WPUE (10.13) of the individual capture methods followed by trapnets (WPUE = 0.9) and electrofishing (WPUE = 0.5). Total length of Largescale Sucker ranged from 97 and 630 mm, however most (approximately 80%) of fish were between 460 and 560 mm (Figure 11).

Lucky Peak Reservoir

A total of 381 fish were captured during the standard lowland lake survey at Lucky Peak Reservoir in 2019 (Table 6). Catch was predominately Bridgelip Sucker (*n* = 100), Largescale Sucker (*n* = 89) and Northern Pikeminnow (*n* = 68). Other species captured include Black Bullhead, fall Chinook Salmon, Chiselmouth, kokanee, Mountain Whitefish, Rainbow Trout, Redside Shiner, Smallmouth Bass and Yellow Perch (Table 7). CPUE and WPUE indices for combined species were 18.14 and 6.69, respectively (Table 7). Electrofishing was the most effective gear type with a total CPUE of 86.5, followed by gill nets (CPUE = 16.6) and trap nets (CPUE = 4.67). Based on CPUE, Bridgelip Sucker made up 26% of the total catch, followed by Largescale Sucker (23%), and Northern Pikeminnow (18%). All the other species collected contributed <1% of total catch (Table 7). Based on WPUE, the fish community consisted of Largescale Sucker (40%), Bridgelip Sucker (23%), and Northern Pikeminnow (22%). Remaining species collected represented less than 5% of the total biomass (Table 6).

Bridgelip Sucker were the most abundant fish sampled by CPUE (*n* = 100). They were captured with a total CPUE of 4.67 and a WPUE of 1.55 (Table 6). Electrofishing yielded the highest CPUE (24.5) of the individual capture methods followed by gill nets (CPUE = 2.7) and trapnets (CPUE = 2.67). Total length of Bridgelip Sucker ranged from 84 and 540 mm, however most (approximately 67%) fish were between 150 and 330 mm (Figure 11).

Largescale Sucker were the most abundant fish sampled by WPUE (*n* = 89). They were captured with a total CPUE of 4.67 and a WPUE of 1.55 (Table 6). Electrofishing yielded the highest CPUE (24.5) of the individual capture methods followed by gill nets (CPUE = 2.7) and trapnets (CPUE = 2.67). Total length of Largescale Sucker ranged from 84 and 541 mm, however most (approximately 54%) of fish were between 400 and 500 mm (Figure 12).

DISCUSSION

Creel Survey

While kokanee effort and success is highly variable from year to year, Rainbow Trout fisheries have remained much more consistent from year-to-year in both reservoirs. In comparison, historic proportion of kokanee anglers has varied drastically due to the fish's short life cycle, as well as variable growth and survival of kokanee. Furthermore, targeting kokanee typically requires extensive knowledge and is relatively gear-intensive, and kokanee anglers are somewhat of "specialists". Comparatively, targeting Rainbow Trout is less gear-intensive and caters more towards "generalist" anglers, which may contribute to the differences in effort and therefore success.

However, kokanee anglers experienced lower than average catch rates in both Arrowrock and Lucky Peak reservoirs during annual creel surveys in 2019. No interviewed anglers from either reservoir water caught a limit of kokanee in 2019, and there was a higher proportion of anglers who were unable to harvest a single kokanee in 2019 compared to previous years. As observed over the course of these surveys, these metrics continue to confirm the highly variable nature of these fisheries.

Declining trends in kokanee fishing at Lucky Peak and Arrowrock reservoirs may be attributed to a combination of factors. The list of potential factors include water supply and management associated with record high 2017 runoff, slight earlier shift in stocking, smaller fingerling size at stocking, and variable entrainment levels (from both Arrowrock Reservoir into Lucky Peak Reservoir and from Lucky Peak Reservoir into the lower Boise River). In addition, based on observations from the 2019 stocking, we are concerned with differences in water temperature of up to 8º C between hatchery truck and reservoir conditions at stocking. Thermal differences observed in 2019 may result in adverse effects on kokanee fingerling survival and recruitment to the fishery.

Age-2 Kokanee CPUE and Size Evaluation

Models were generated through a stepwise model selection framework to predict length of age-2 kokanee as a function of various reservoir conditions. The best model to estimate kokanee length at age-2 for Lucky Peak Reservoir contained a number of reservoir conditions, including maximum storage, minimum inflow and minimum outflow during year 2. Similarly, the best model to estimate kokanee length at age-2 for Lucky Peak Reservoir fish based on Arrowrock Reservoir conditions also contained (among other variables) maximum storage, minimum storage, August and September storage and maximum inflow during year 2. Additionally, when the Lucky Peak kokanee fishery was compared against Arrowrock Reservoir conditions, maximum storage, minimum storage, August and September storage and maximum inflow during year 2 all were included in the top model. The prevalence of these reservoir conditions during the second year post-stocking in the eventual prediction of kokanee length at age-2 suggest a delayed effect of water operations in future kokanee fisheries at Lucky Peak and Arrowrock reservoirs. When the top model predicting Lucky Peak Reservoir kokanee length at age-2 is compared to the next closest model in the candidate set, there is a large difference in AIC values (ΔAIC = 29.5) between this “best model” and the next closest model. However, there is only one additional model term; number of kokanee stocked. This may suggest the number of kokanee stocked plays a large role in predicting length of age-2 kokanee in Lucky Peak Reservoir. Kokanee are highly density dependent, and as such we would expect that number stocked has a negative effect on length of age-2 fish.

The best model to estimate angler CPUE of age-2 kokanee in Lucky Peak and Arrowrock reservoirs, as well as comparisons of Arrowrock conditions to Lucky Peak angler CPUE was the intercept model. At this time, we have a number of theories as to why the linear stepwise model selection framework selected the intercept model as the best fitting model to predict angler CPUE based on the aforementioned environmental variables. During the past decade, kokanee catch rates have been typically low, averaging less than one fish per hour at both reservoirs. In addition, these low catch rates have also not varied much over the past decade. The limited variability and low overall catch rates may be difficult to encompass in a model selection framework such as this. Additionally, as noted above, environmental and water operations variables were used in the model selection framework to predict length of age-2 kokanee at both reservoirs. As noted above, kokanee are highly density dependent, and typically fish size is negatively correlated with densities, which may be influencing low catch rates. Finally, a linear model selection framework may not be fully encompassing the dynamic and potentially cyclic nature of kokanee fisheries that are supported primarily with hatchery stock and limited natural recruitment such as Lucky Peak and Arrowrock Reservoir.

How these factors are influencing catch in both waters needs further investigation. These relationships at both reservoirs continue to fluctuate with the addition of stocking years to the dataset, but are more and more telling as the dataset and sample sizes increase. Observed relationships are likely to continue to fluctuate from year to year as the dataset grows and it may take some time for us to understand what factors truly are having the greatest impacts on length and CPUE of age-2 kokanee in both Lucky Peak and Arrowrock reservoirs.

Kokanee Abundance Gillnetting

Fall kokanee abundance indices have been difficult to build based on the low catch rates we have experienced for the last several years. A 2016 graduate study found that using overnight experimental curtain gill net sets, suspended in the kokanee layer of the water column, was the most effective tool to capture and monitor kokanee adult populations in Arrowrock and Lucky Peak reservoirs. Based on this finding, since 2017, gill nets have been used as the primary tool for annually sampling these populations in both reservoirs. From 2017 to 2019, gill net samples from both reservoirs provided low numbers of kokanee. As gill net indices are established over the next several years, it will be important for us to gain a better understanding of an appropriate number of nets to adequately sample the population and provide an appropriate estimate of age-specific populations each fall. Our hope is that as these populations rebound and catch rates improve, our ability to predict adult abundance based on fall gillnet catch with improve.

Low capture rates of age-0 kokanee in Lucky Peak Reservoir made it difficult to assess entrainment from Arrowrock for fish stocked in 2019. However, age-1 adipose clipped kokanee were recovered at a similar rate to the age-0 recoveries in 2018, further confirming that a large proportion of the kokanee in Lucky Peak entrained from Arrowrock during that flow year. We will continue to look for adipose-clipped kokanee to further monitor entrainment and gain a better understanding of its variability through time. Starting in 2020, we will begin utilizing thermal marks unique to each cohort (as part of a size-at-release evaluation), in hopes to track age-specific entrainment of kokanee.

Thermally-marked otoliths will continue to be utilized to estimate natural versus hatchery origin kokanee in both Lucky Peak and Arrowrock reserviors. 2019 was the third consecutive year of using thermally marked otoliths to identify hatchery and natural-origin kokanee recovered from gillnets. In 2017, 23% of the age-1 kokanee from Lucky Peak and 49% of the age-1 kokanee from Arrowrock were of natural origin. In 2018, the Lucky Peak proportion of natural origin age-1 fish was down to 10% and no natural origin age-1 fish were sampled in Arrowrock Reservoir. In 2019 we did not observe any thermally marked otoliths from either Lucky Peak or Arrowrock Reservoir. However, five kokanee from Lucky Peak Reservoir had clipped adipose fins, indicating hatchery origin. We believe this discrepancy can be attributed to errors in processing otoliths for thermal marks. Age-1 natural origin fish would have spawned in the fall of 2017 and emerged in the spring of 2018. Fraley et al. (1986) found that kokanee emerged from mid-March through mid-May in McDonald Creek, MT. Spring flows in the Boise Basin in 2017 were exceptionally high. By April 1st of 2017, the upper South Fork Boise River above Anderson Ranch and the Middle Fork Boise River above Arrowrock experienced flows over 400% of average, while Mores Creek experienced flows over 360% of average. These high flows could have had a negative impact on wild kokanee survival. Given the previously described findings of high rates of entrainment between reservoirs, natural-origin kokanee recovered in Lucky Peak and Arrowrock reservoirs could be from a variety of source populations throughout the Boise River Basin. Additionally, the high proportion of natural-origin kokanee observed in both waters in 2017 might be elevated given the overall low numbers of age-1 hatchery origin fish present.

The kokanee fisheries in Lucky Peak and Arrowrock reservoirs are popular. These two large Boise River Basin reservoirs (along with Anderson Ranch Reservoir in the Magic Valley Region) produce a high level of regional angling effort annually and the demand for these fisheries continues to increase. Recent trends in decreased catch rates at Lucky Peak Reservoir along with inconsistent fisheries in Arrowrock Reservoir are concerning. Continued monitoring of angler catch and effort, environmental variability, population trends, entrainment, and hatchery/natural composition have emphasized the complexity of this system. Continued data collection will help managers further understand these relationships and improve the management of these complex sport fisheries.

Predator Gillnetting

The predominant species captured in the preliminary predator gillnets was Northern Pikeminnow. While this is not an unexpected result, it was curious that no kokanee fingerlings were found in Northern Pikeminnow stomachs. The only fishes that had kokanee fingerlings in their stomachs were larger kokanee, which was unexpected. While the sample size of large kokanee captured in gillnets was low (n = 3), each of them contained at least one kokanee fingerling. Kokanee are known planktivores, and this dietary shift raises a number of questions. Due to the small sample sizes and surprising result, we will likely repeat these predator gillnet surveys in the future to determine predation rates on kokanee fingerlings.

Lowland Lake Surveys

Arrowrock Reservoir

Since the last lowland lake survey at Arrowrock Reservoir (June 2012), the species composition has not drastically changed. During the 2012 survey, Northern Pikeminnow and sucker spp. comprised 91% of the total biomass. During the 2019 survey, Northern Pikeminnow and sucker spp. comprised 82% of the total biomass. Very few gamefishes were captured, with only Smallmouth Bass comprising more than 5% of the total catch by either CPUE or WPUE.

As a result of the 2012 Arrowrock Reservoir lowland lake survey, the Department coordinated with BOR, removal netting efforts targeting nongame fishes. During the removal efforts, nearly 6,600 kg of nongame fishes were removed. As mentioned, costs were shared between agencies; as such IDFG costs were limited to personnel costs (~$2,500). Overall project success was inconclusive, as a significant decrease in nongame fish biomass was not observed, nor was a significant increase in sportfish biomass. However, monetary investment from the Department was minimal. Less than a decade later, fishery managers find themselves facing a similar question. In 2019, overall catch was dominated by nongame fishes, despite overall catch being lower when compared to the previous standardized lowland lake survey. However, we conducted the standardized lowland lake survey at Arrowrock Reservoir during late July, whereas the previous survey was conducted in early June. We believe that the difference in timing may have factored into our lower catch rates. During the 2012 lowland lake survey, Arrowrock Reservoir was held at 3213’ elevation, whereas during the 2019 lowland lake survey, Arrowrock Reservoir was held at 3177’ elevation. This 36’ difference caused sample locations which are typically in shallow littoral habitats to shift towards deeper, pelagic habitats, which may have limited capture efficiency. Furthermore, the 41-day difference in survey dates likely affected catch. Earlier in the season, fishes such as Smallmouth Bass are in shallow, littoral habitats for spawning, however later in the season those fish move out of the shallows and into deeper habitat with decreased water level and warming surface water temperatures (Hubert and Lackey 1980, Beamesderfer and Rieman. 1991).

Standardized lowland lake surveys are designed to reduce biases, by utilizing a number of different gear types with broad spatial distribution. However, these gear types may not be adequately characterizing sportfish composition. For example, kokanee are a prized gamefish across their range, and Arrowrock Reservoir is no exception. Kokanee are typically found in the pelagic zone at intermediate depths, and are most susceptible to gillnets. The gillnet sets used in the standardized lowland lake surveys are typically littoral and either sinking or floating nets. Additionally, when evaluated at the gear-specific level, the majority of Smallmouth Bass (~52%) were captured via electrofishing, and Smallmouth Bass contributed the majority (~62%) of the total electrofishing catch. Biases in capture probability, especially with regard to electrofishing, are well documented across a number of taxa including salmonids (Peterson et al. 2004) and centrarchids (Dauwalter and Fisher 2007). In order to properly estimate biases in gear selectivity, typically mark-recapture or depletion estimates are used. In a lacustrine environment such as Arrowrock Reservoir, a depletion estimate would be logistically impossible to conduct at the reservoir-wide scale, and it would be difficult to partition the reservoir into smaller sample units without violating an assumption of physical closure (i.e. block nets) due to the physical geography and steep-sided nature of the reservoir. A mark-recapture estimate would be extremely logistically intensive in terms of gear and man-hours required, albeit not completely impossible. However, under the context of a lowland lake survey, we are merely estimating relative densities and species composition. Furthermore, based on information gained from annual creel surveys, Smallmouth Bass play a minor role in the desires of our constituents at Lucky Peak and Arrowrock reservoirs. In the future, should the Department have an increased desire for a more fine-scale evaluation of Smallmouth Bass in these reservoirs, an intensive mark-recapture evaluation may be the best avenue to estimate demographics while also accounting for gear biases.

Lucky Peak Reservoir

Since the last lowland lake survey at Lucky Peak Reservoir (June 2009), the species composition has not drastically changed. During the 2009 survey, Northern Pikeminnow and sucker spp. comprised 68% of the total biomass. During the 2019 survey, Northern Pikeminnow and sucker spp. comprised 67% of the total biomass. Very few gamefishes were captured, with only Smallmouth Bass comprising more than 5% of the total catch by either CPUE or WPUE.

Timing differences in the two lowland lake surveys conducted on Lucky Peak Reservoir need to be accounted for prior to making any decisions regarding results of these surveys. After the 2009 Lucky Peak Reservoir lowland lake survey, management recommendations focused on maintaining high quality fisheries for both kokanee and Rainbow Trout. Managers acknowledged that nongame fishes comprised a large proportion of the total catch, which was accepted due to the prolific sportfisheries. When compared to the 2009 Lucky Peak Reservoir lowland lake survey, the 2019 survey yielded similar proportions on nongame fishes. However, overall catch was significantly lower than previous surveys. As mentioned above for Arrowrock Reservoir, timing of lowland lake surveys was different between the 2009 and 2019 surveys. Due to staff turnover, we conducted the standardized lowland lake survey at Lucky Peak Reservoir during late July 2019, 45 days later than the previous survey in 2009. We believe that the difference in timing may have factored into our lower catch rates. Earlier in the season, fishes such as Smallmouth Bass are in shallow, littoral habitats for spawning, however later in the season those fish move out of the shallows and into deeper habitat with decreased water level and warming surface water temperatures (Hubert and Lackey 1980, Beamesderfer and Rieman. 1991). As such, proportional catch of Smallmouth Bass decreased from 2009 (14%) to 2019 (6%). As mentioned above, species-specific gear selectivity may have additionally affected indices such as proportional catch, CPUE, and WPUE during lowland lake surveys.

Based on the aforementioned discrepancies between the 2019 lowland lake surveys and the previous ones (2009 and 2012), we are planning on repeating the lowland lake surveys in 2020 so that we can draw more applicable comparisons between lowland lake conditions. We do not plan on deviated from the established lowland lake protocol or historic sample locations, however we anticipate potential differences in catch due to timing, lake elevation, water temperature and other abiotic factors.

RECOMMENDATIONS

1. Continue to monitor the effect of kokanee stocking practices and environmental conditions at Arrowrock and Lucky Peak reservoirs by indexing CPUE using annual check stations during May.

2. Modify kokanee stocking location at Lucky Peak Reservoir to minimize differences in temperature between hatchery truck and reservoir conditions.

3. Continue to use curtain gill nets to evaluate kokanee relative abundance through annual index surveys.

4. Repeat predation gillnetting following kokanee stocking.

5. Evaluate thermal marks of hatchery-origin kokanee to be stocked in Arrowrock Reservoir to monitor entrainment into Lucky Peak Reservoir.

6. Repeat lowland lake survey at Lucky Peak or Arrowrock Reservoir in early June to compare to previous lowland lake surveys at similar temporal scales.

Table 1. Waterbody, year, date, number of kokanee, size, fish/lb and stocking density (fish/ha and lb/ha) for Arrowrock and Lucky Peak reservoirs between 2004 and 2019.

Waterbody	Year	Date	No. Fish	Mean size (mm)	Fish/lb	Stocking density (fish/ha)	Stocking density (lb/ha)
Arrowrock Reservoir (ha)	2004	14-Jun	77,025	100	41.1	61	1.5
1,255	2006	9-May	70,000	89	79.1	56	0.7
	2010	3-Jun	29,000	79	116	23	0.2
	2011	8-Jun	30,000	76	100	24	0.2
	2012	2-May	50,130	76	111.4	40	0.4
	2013	1-May	50,160	69	152	40	0.3
	2014	15-May	49,995	76	97.1	40	0.4
	2015	13-May	101,198	81	95.7	81	0.8
	2016	4-May	99,992	81	100.9	80	0.8
	2017	7-Jun	103,579	84	92	83	0.9
	2018	5-Jun	98,580	69	164	79	0.7
	2019	5-Jun	100,644	75	130.2	80	0.6
Lucky Peak Reservoir (ha)	2004	14-Jun	155,950	90	108.4	135	1.2
1,153	2005	3-Jun	200,150	86	75.5	174	2.3
	2006	24-May	308,050	83	101	267	2.6
	2007	31-May	245,000	89	87.5	212	2.4
	2008	3-Jun	195,570	57	288.4	170	0.6
	2009	3-Jun	199,800	83	99.9	173	1.7
	2010	3-Jun	151,050	79	100.7	131	1.3
	2011	8-Jun	174,640	76	94.4	151	1.6
	2012	2-May	200,910	76	107.9	174	1.6
	2013	1-May	251,877	69	148.6	218	1.5
	2014	15-May	237,120	76	98.8	206	2.1
	2015	13-May	250,515	81	87.9	217	2.5
	2016	4-May	252,993	81	99.8	219	2.2
	2017	18-Apr	99,998	49	478	87	0.2
	2017	7-Jun	194,220	78	117	168	1.4
	2018	5-Jun	214,310	71	148	219	2.2
	2019	5-Jun	501,468	75.6	126.2	435	3.4

Table 2. Date, day type, time period, and number of anglers interviewed for creel check stations at Arrowrock and Lucky Peak reservoirs in May, 2019.

Date	Day type	Time period	Arrowrock	Lucky Peak
29-Apr	Weekday	Late	31	24
5-May	Weekend/Holiday	Early	155	107
8-May	Weekday	Early	9	8
24-May	Weekday	Early	43	18
26-May	Weekend/Holiday	Late	97	59
Total			335	216

Table 3. Angler CPUE by day type, time period, and target species for kokanee and Rainbow Trout at Arrowrock and Lucky Peak reservoirs in May, 2019.

Strata	Kokanee (fish/h)		Rainbow Trout (fish/h)	
	Arrowrock	Lucky Peak	Arrowrock	Lucky Peak
Weekday	0.11	0.00	0.78	0.38
Weekend/Holiday	0.11	0.03	0.37	0.22
Early	0.06	0.03	0.44	0.21
Late	0.18	0.03	0.54	0.34
Kokanee Target	0.25	0.00	0.83	0.67
Rainbow Trout Target	0.02	0.03	0.21	0.12
All	0.08	0.03	0.48	0.26

Table 4. Waterbody, age and origin of 2019 gill net sampled kokanee from Lucky Peak and Arrowrock reservoirs as determined by otolith thermal marks.

Waterbody		Hatchery Origin		Natural Origin	
		Age-0	Age-1	Age-0	Age-1
Lucky Peak	Number	4	0	24	11
	Percent	10.3	-	61.5	28.2
	Mean TL (mm)	175.0	-	164.8	308.7
Arrowrock	Number	0	0	5	4
	Percent	-	-	55.5	44.5
	Mean TL (mm)	-	-	145.4	249.0

Table 5. Species, number captured (*n*) and CPUE (fish/net) of fish sampled during predator gillneting in Lucky Peak Reservoir.

Species	n	CPUE (fish/net)
Northern Pikeminnow	41	13.67
Rainbow Trout	7	2.33
Kokanee	5	1.67
Yellow Perch	1	0.33
Chiselmouth	1	0.33
Sucker spp.	28	9.33
Total	83	27.67

Table 6. Waterbody, species, number captured (*n*), CPUE and WPUE of fish sampled during lowland lake surveys at Arrowrock and Lucky Peak reservoirs.

Waterbody	Species	n	CPUE	WPUE
Lucky Peak	Black Bullhead	7	0.33	0.05
	Bridgelip Sucker	100	4.76	1.55
	Chinook Salmon	1	0.05	0.10
	Chiselmouth	55	2.62	0.24
	Kokanee	6	0.29	0.14
	Largescale Sucker	89	4.24	2.66
	Mountain Whitefish	4	0.19	0.07
	Northern Pikeminnow	68	3.24	1.48
	Rainbow Trout	15	0.71	0.31
	Redside Shiner	12	0.57	0.01
	Smallmouth Bass	23	1.10	0.09
	Yellow Perch	1	0.05	0.01
	Total	381	18.14	6.69

Waterbody	Species	n	CPUE	WPUE
Arrowrock	Bridgelip Sucker	6	0.33	0.09
	Bull Trout	2	0.11	0.03
	Kokanee	2	0.11	0.20
	Largescale Sucker	66	3.67	4.82
	Mountain Whitefish	1	0.06	0.02
	Northern Pikeminnow	142	7.89	3.26
	Rainbow Trout	9	0.50	0.21
	Smallmouth Bass	31	1.72	0.15
	Yellow Perch	2	0.11	0.02
	Total	261	14.50	8.81

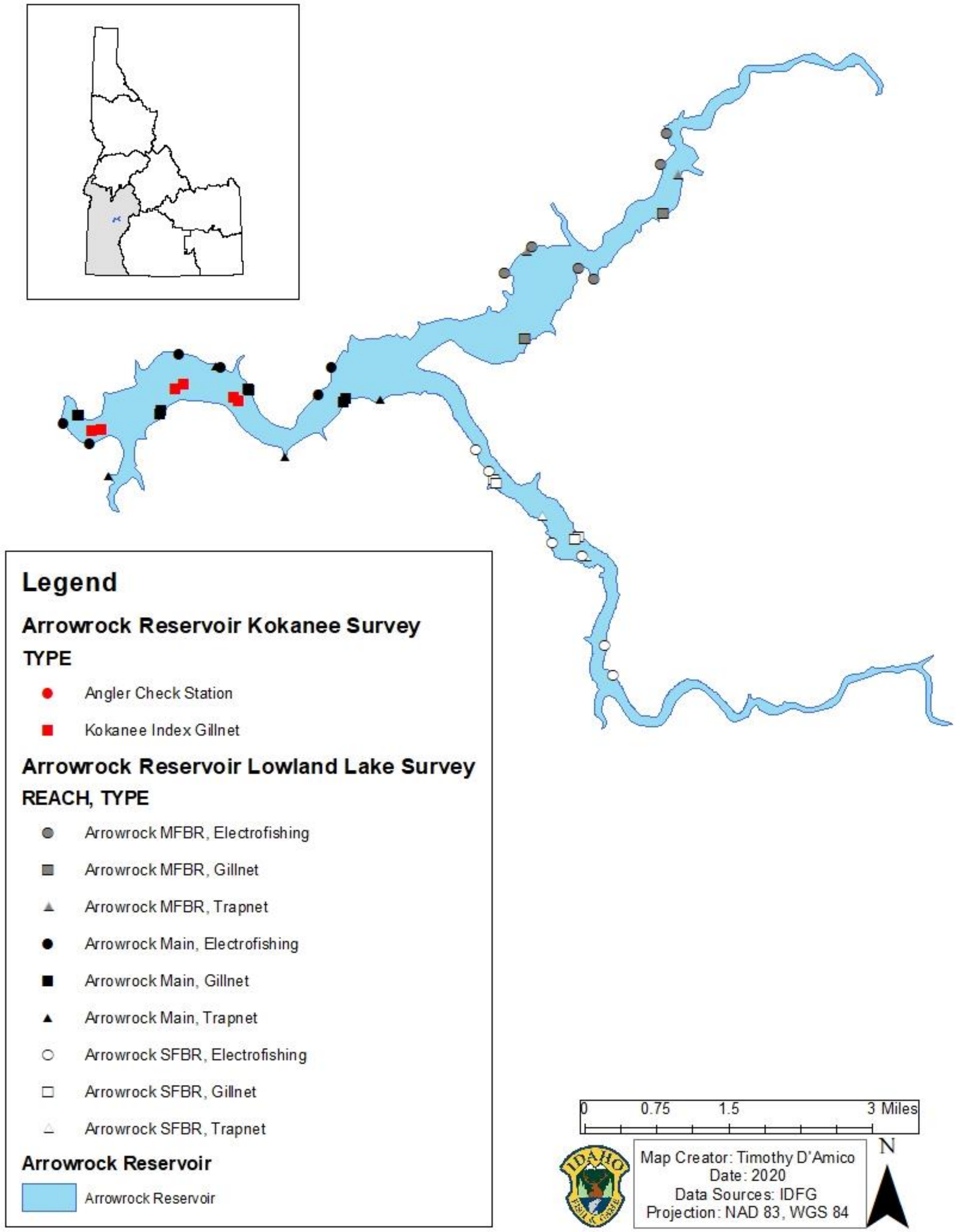

Figure 1. Map of Arrowrock Reservoir, Idaho, with locations of the lowland lake surveys and kokanee index surveys conducted in 2019.

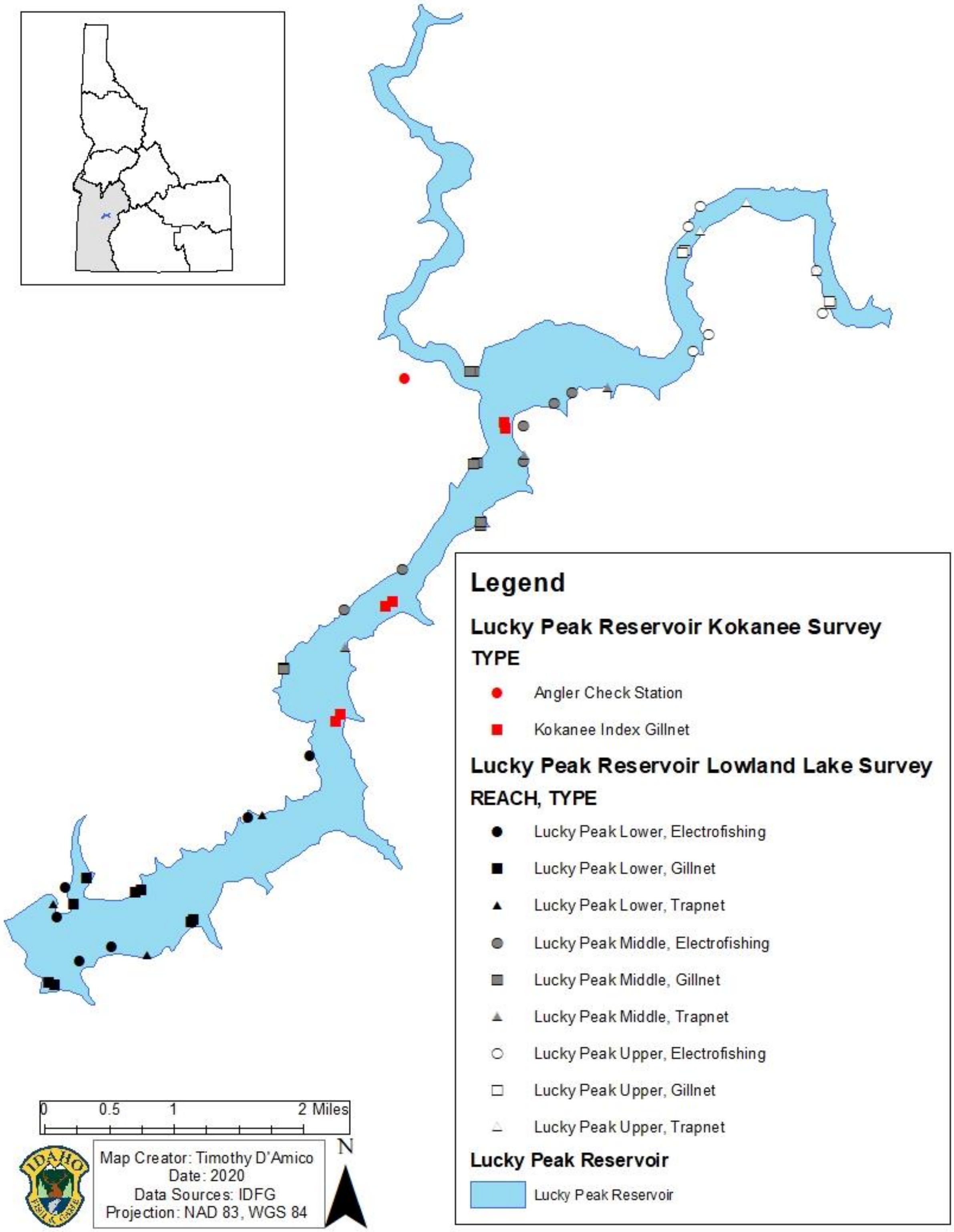

Figure 2. Map of Lucky Peak Reservoir, Idaho, with locations of the lowland lake surveys and kokanee index surveys conducted in 2019.

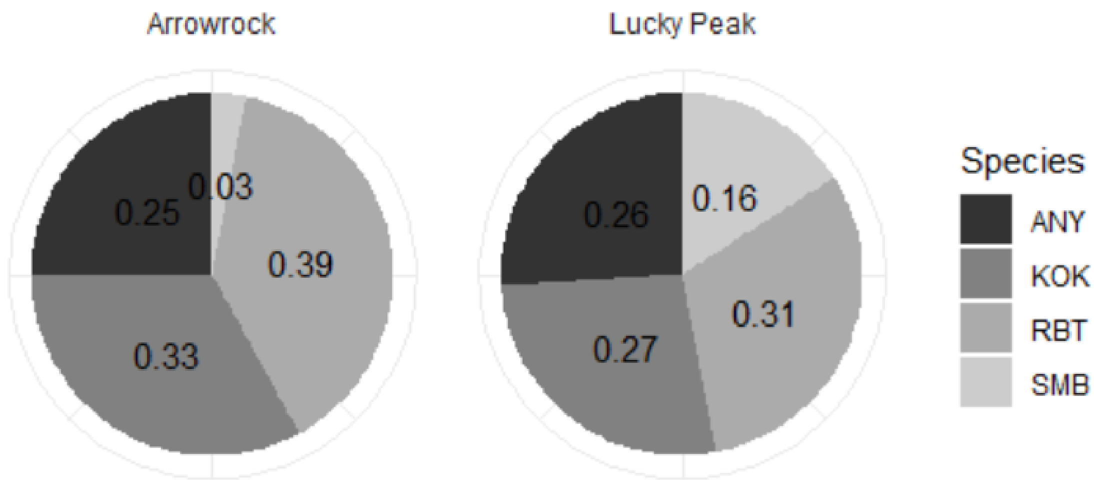

Figure 3. Proportion of anglers targeting game fish species at Arrowrock and Lucky Peak reservoirs based on creel surveys conducted in May 2019.

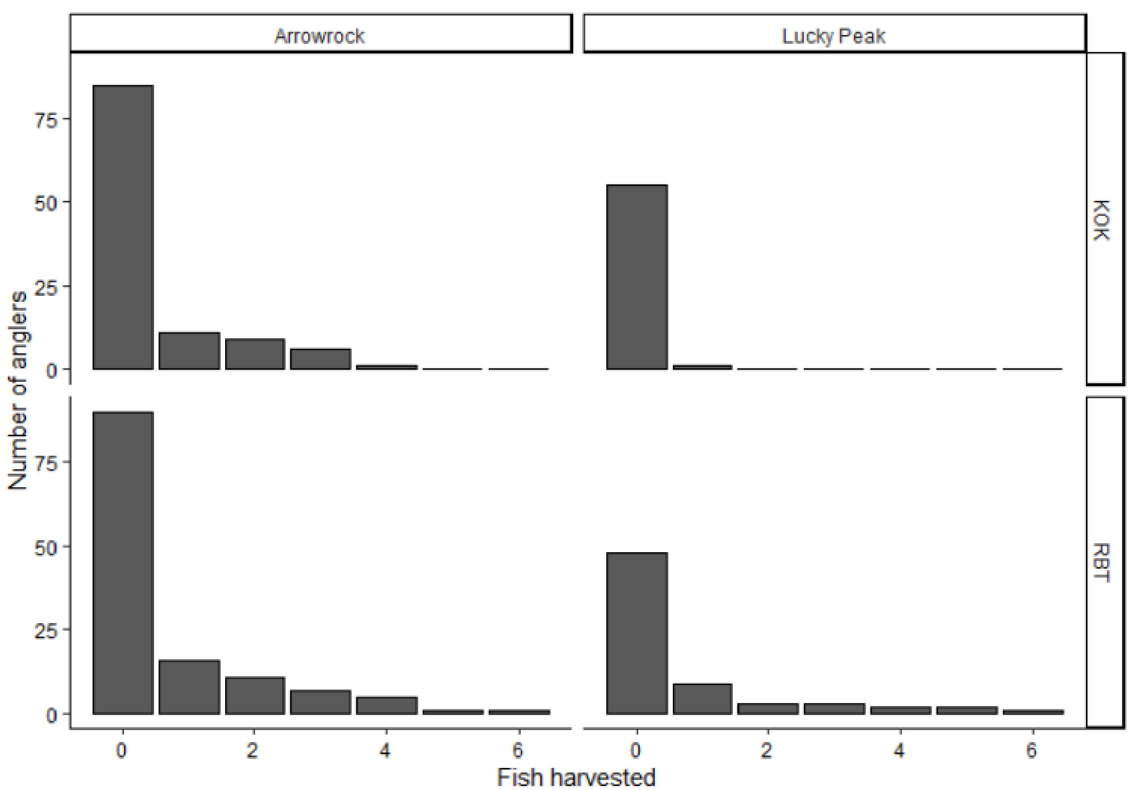

Figure 4. Frequency histograms of fish harvested per angler for kokanee (KOK) and Rainbow Trout (RBT) at Arrowrock and Lucky Peak reservoirs based on creel surveys conducted in May 2019.

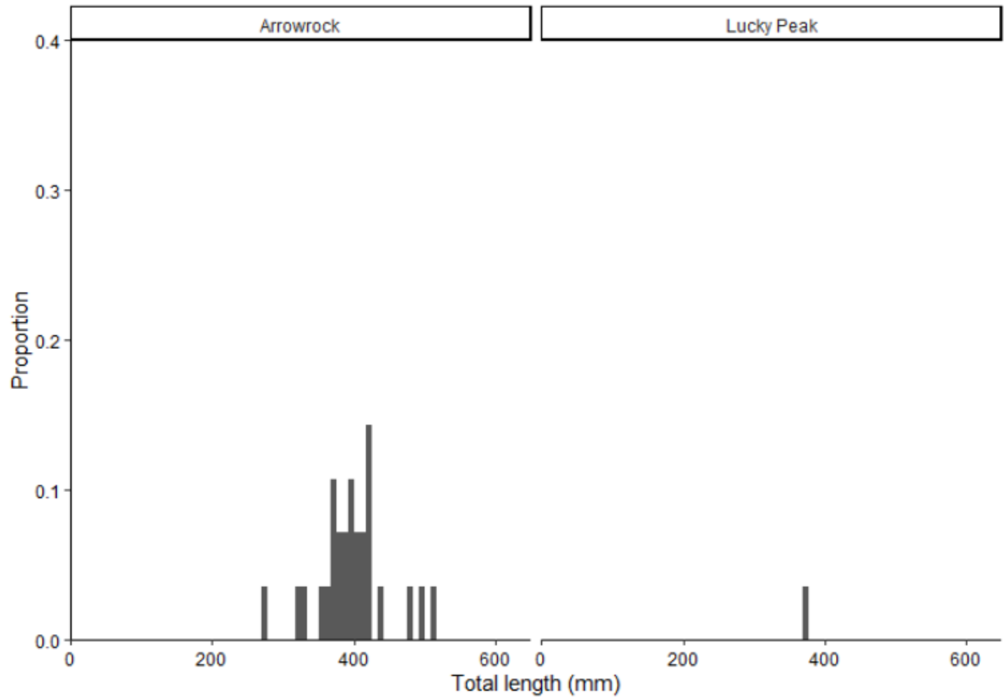

Figure 5. Proportional length frequency histograms of kokanee observed in creel surveys conducted in May 2019 at Arrowrock and Lucky Peak reservoirs.

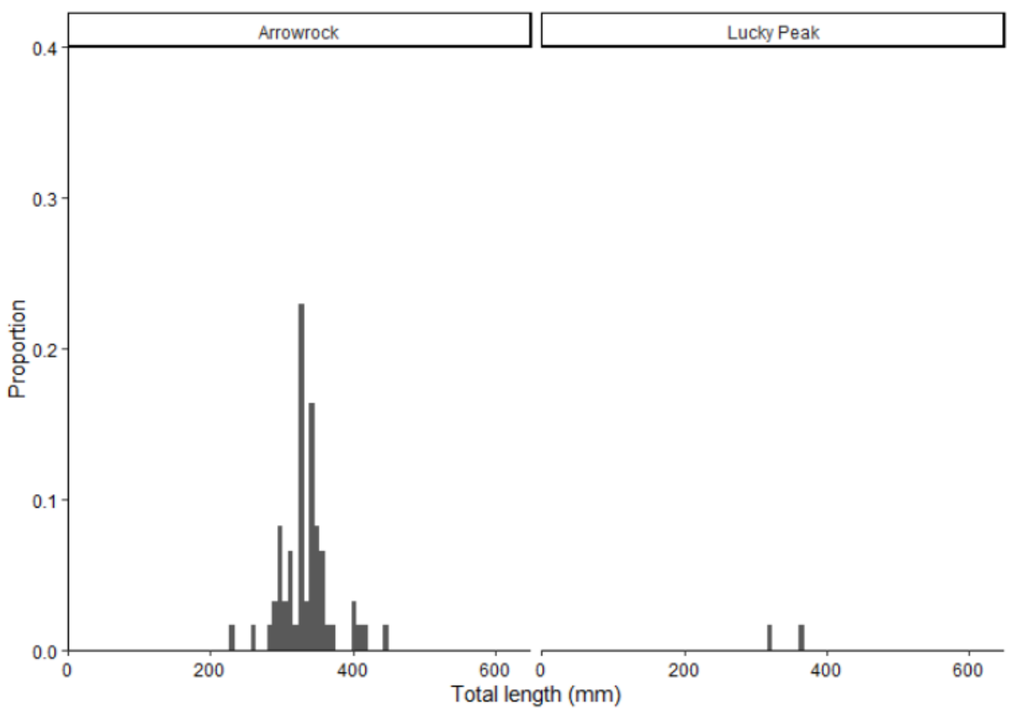

Figure 6. Proportional length frequency histograms of Rainbow Trout observed in creel surveys conducted in May 2019 at Arrowrock and Lucky Peak reservoirs.

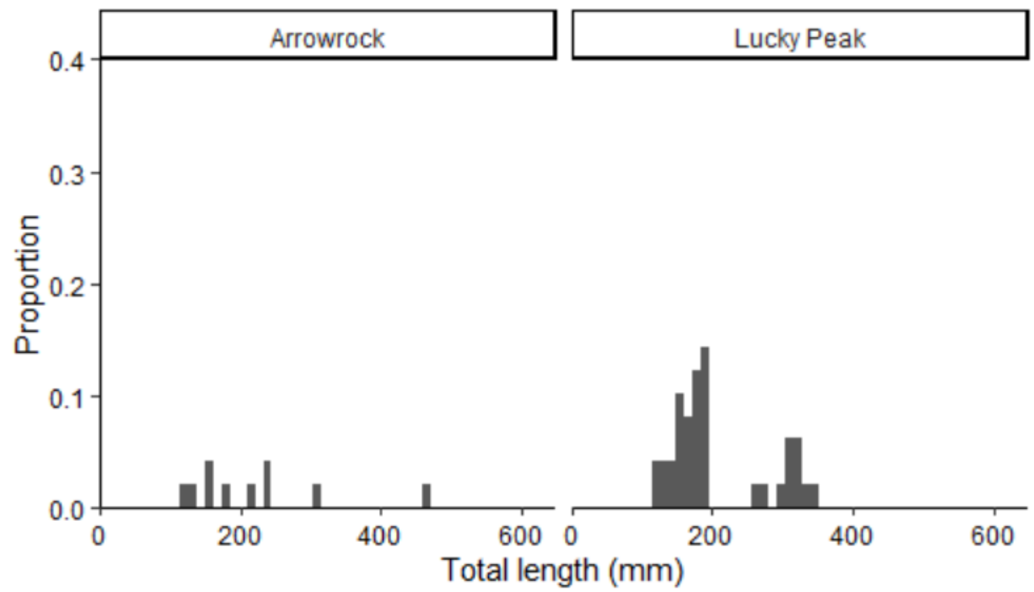

Figure 7. Proportional length frequency histograms of kokanee captured in curtain gill nets in the fall of 2018 at Arrowrock and Lucky Peak reservoirs during kokanee index surveys.

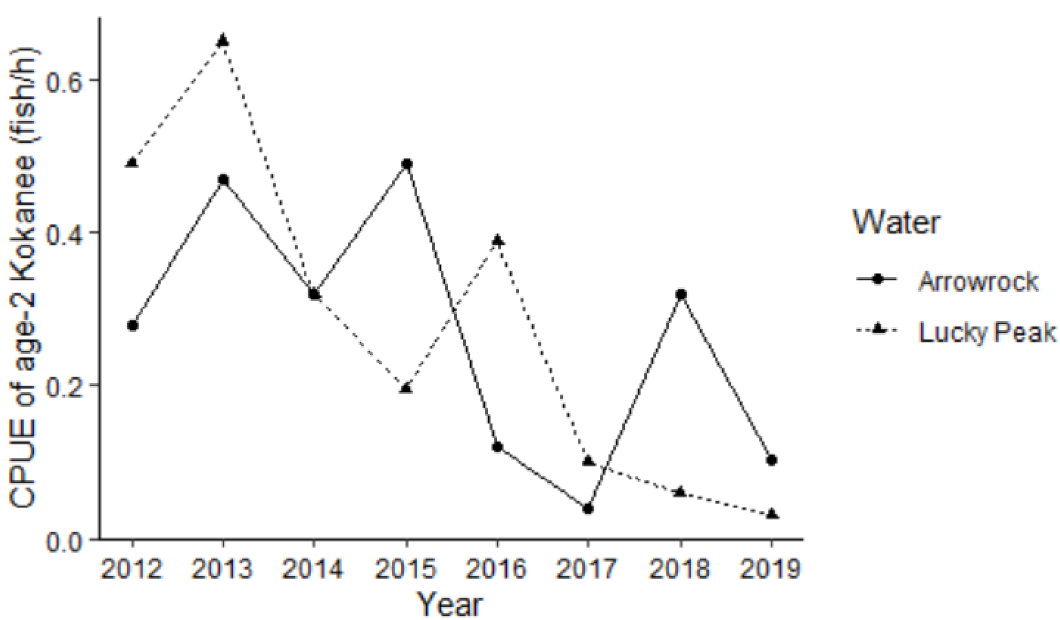

Figure 8a. CPUE (fish/h) of age-2 kokanee by anglers targeting kokanee surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

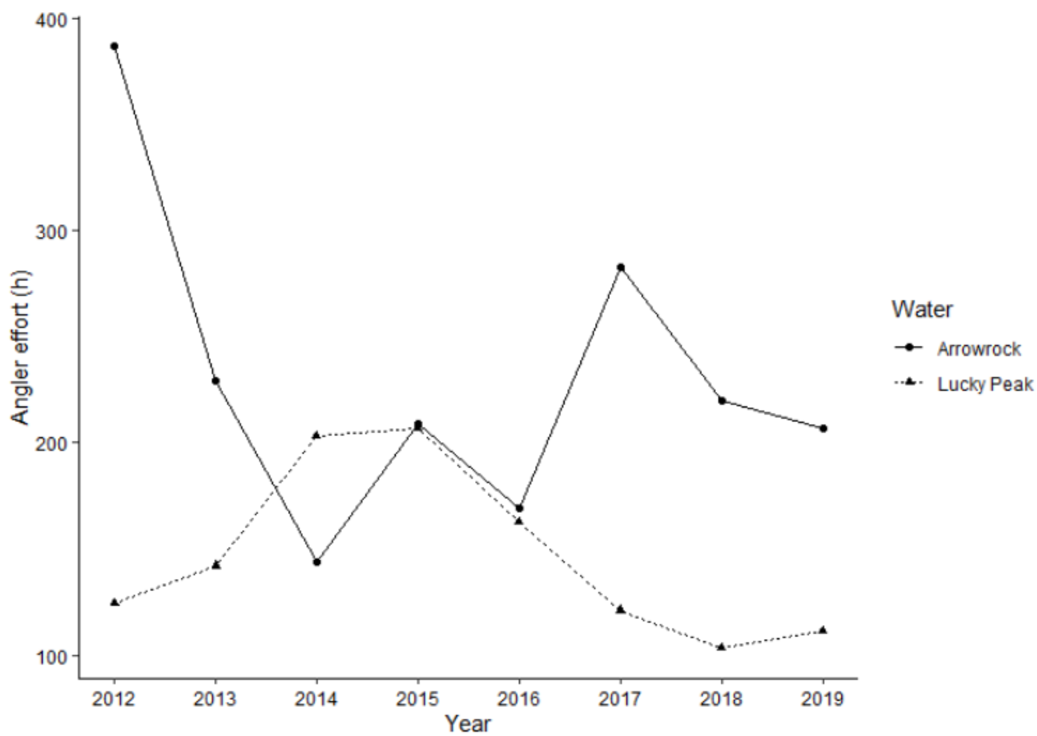

Figure 9b. Angler effort (h) by anglers targeting kokanee surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

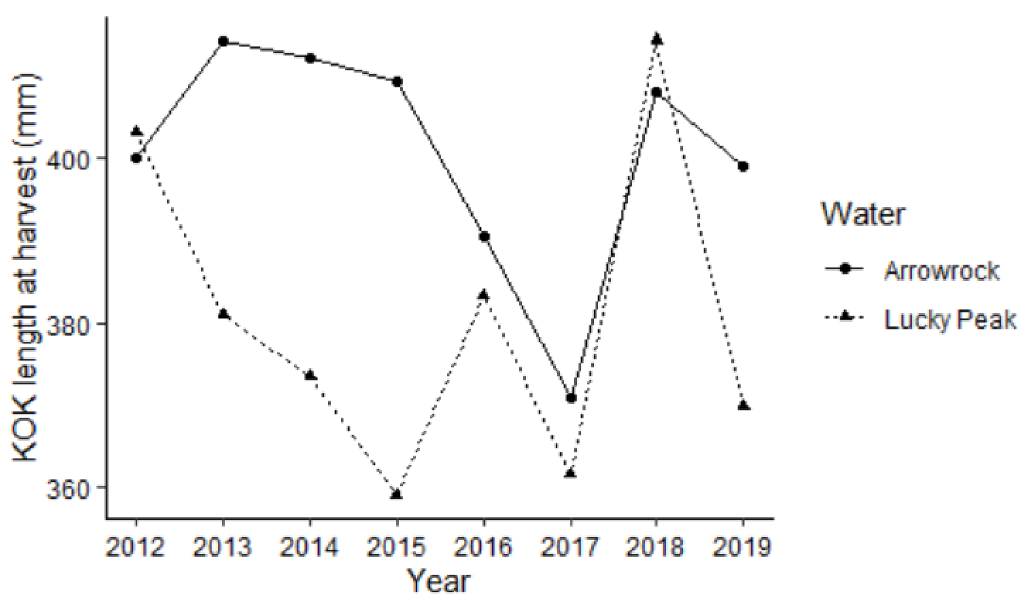

Figure 10c. Kokanee mean length at harvest (mm) by anglers targeting kokanee surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

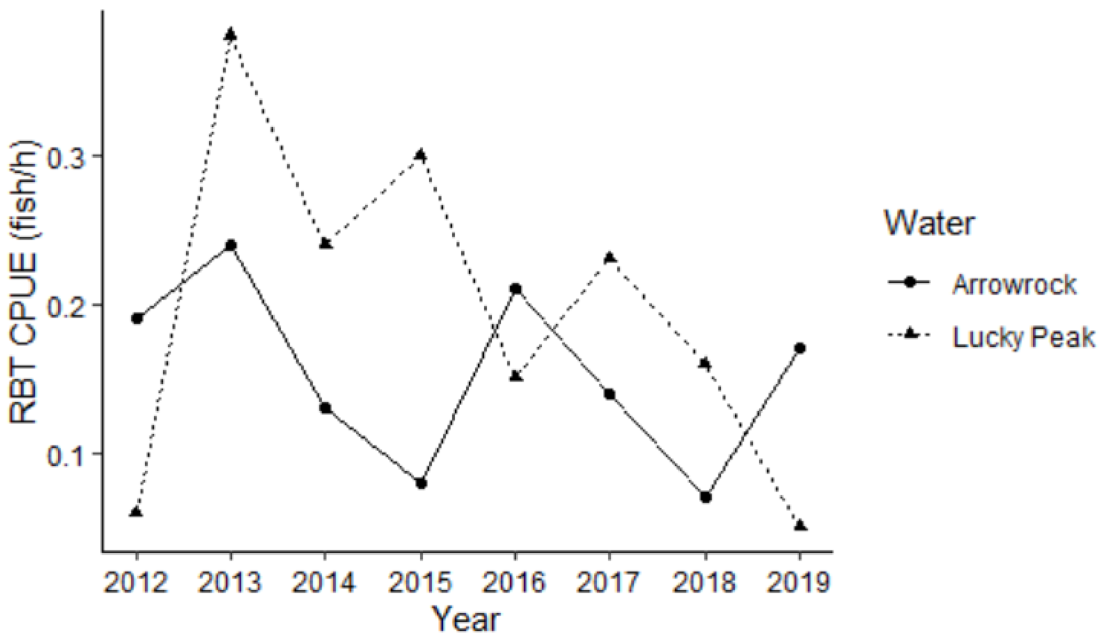

Figure 11a. Rainbow Trout CPUE (fish/h) by anglers targeting Rainbow Trout surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

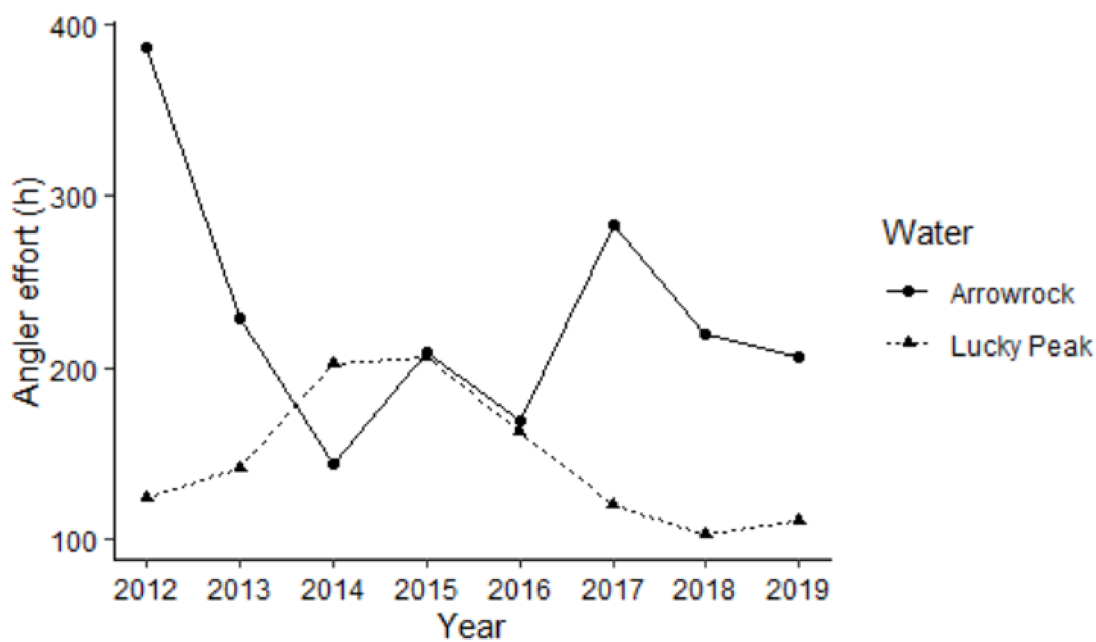

Figure 12b. Rainbow Trout angler effort (h) by anglers targeting Rainbow Trout surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

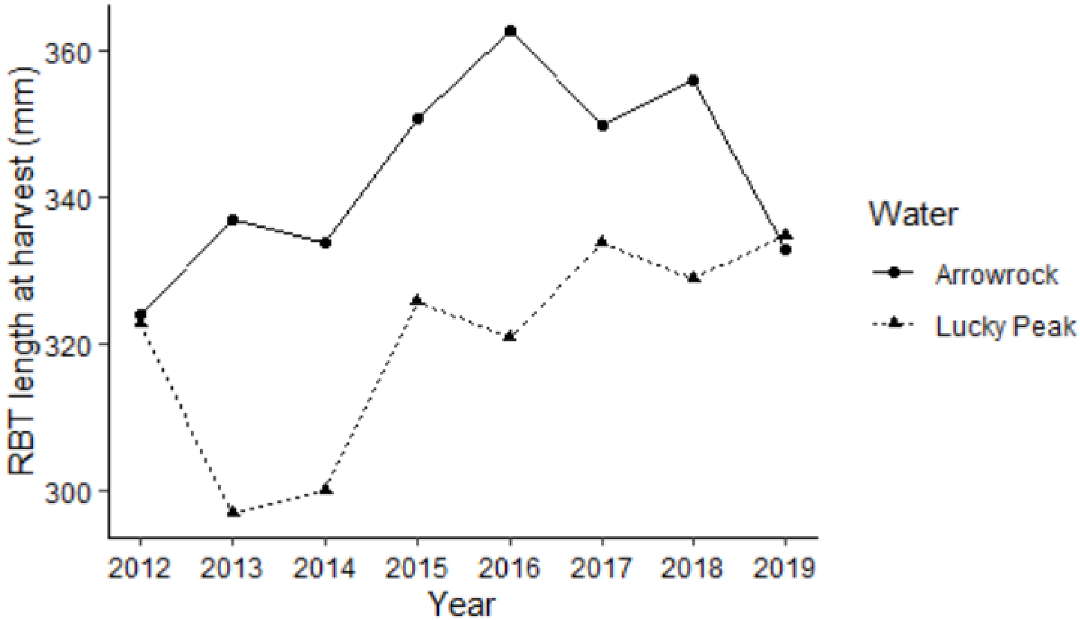

Figure 13c. Rainbow Trout length at harvest (mm) by anglers targeting Rainbow Trout surveyed during creel surveys conducted during May 2012 – 2019 at Arrowrock and Lucky Peak reservoirs.

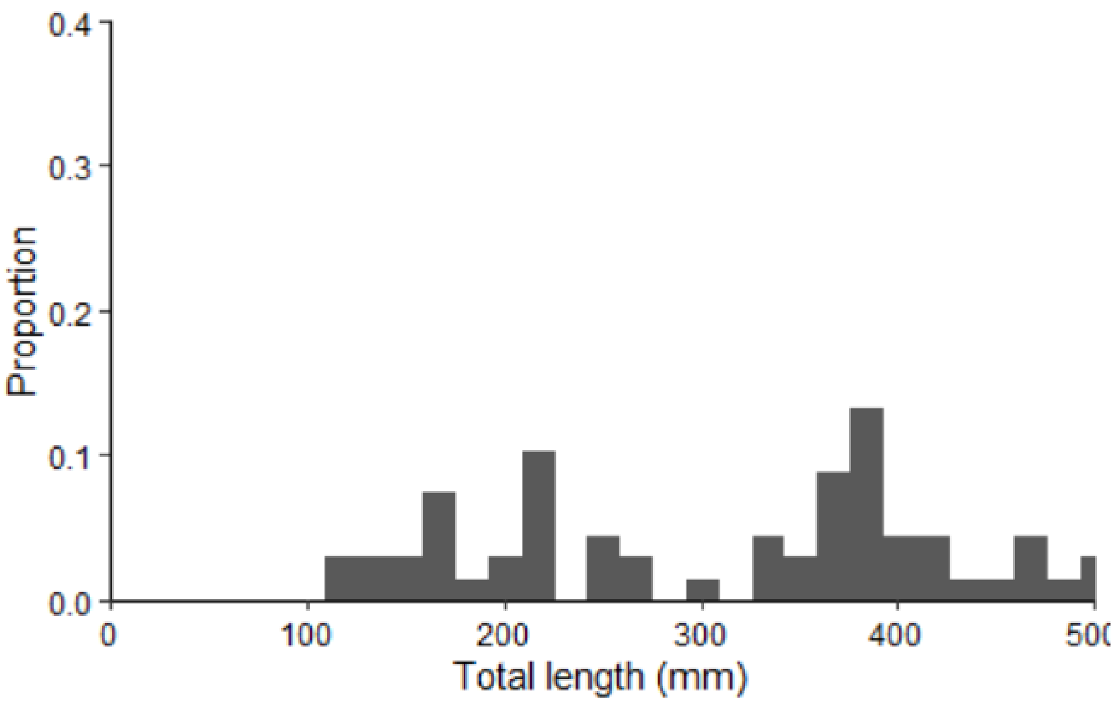

Figure 14. Proportional length frequency of Northern Pikeminnow captured using all gear types during the Lucky Peak Reservoir lowland lake survey in July 2019.

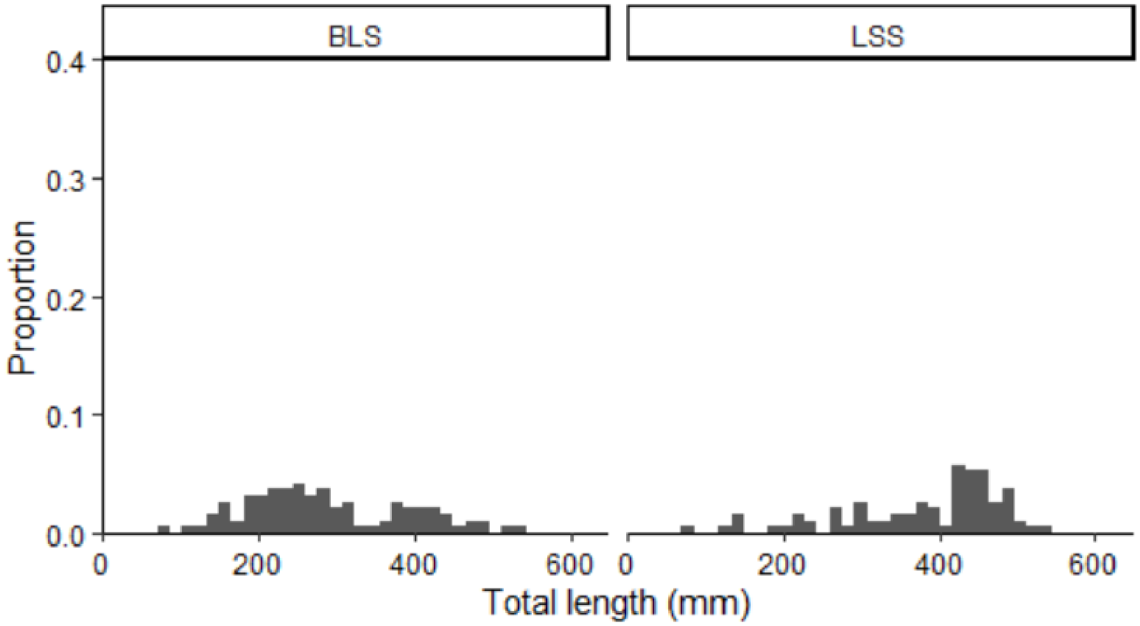

Figure 15. Proportional length frequency of Bridgelip (BLS) and Largescale suckers (LSS) captured using all gear types during the Lucky Peak Reservoir lowland lake survey in July 2019.

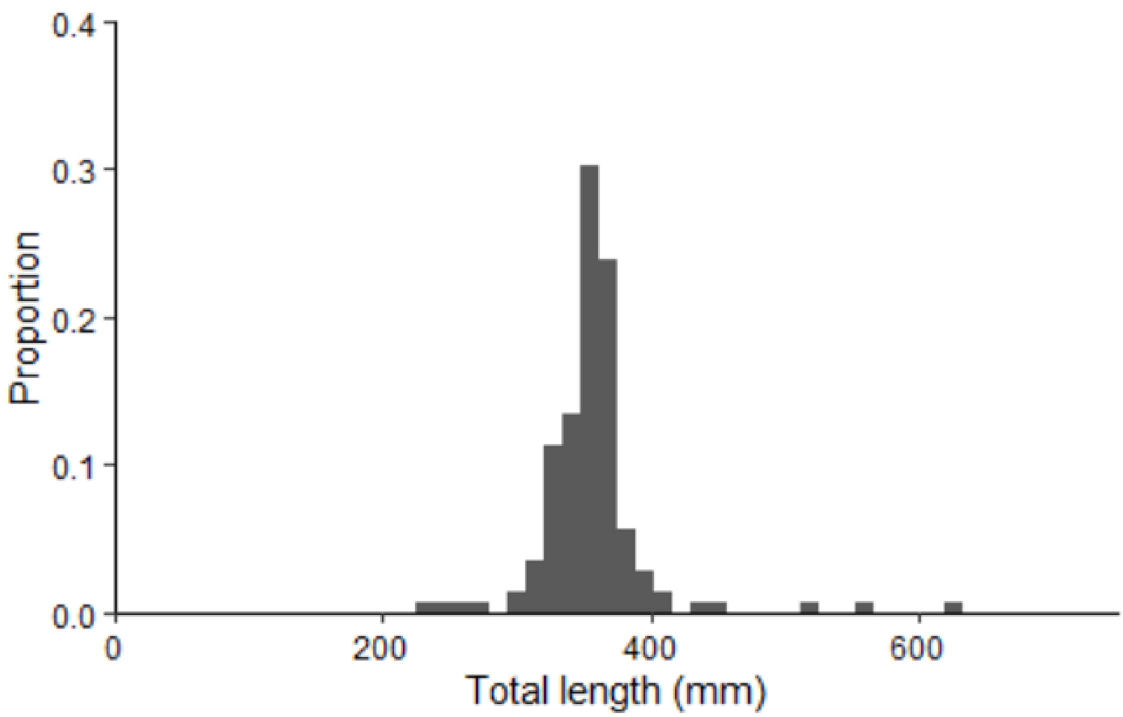

Figure 16. Proportional length frequency of Northern Pikeminnow captured using all gear types during the Arrowrock Reservoir lowland lake survey in July 2019.

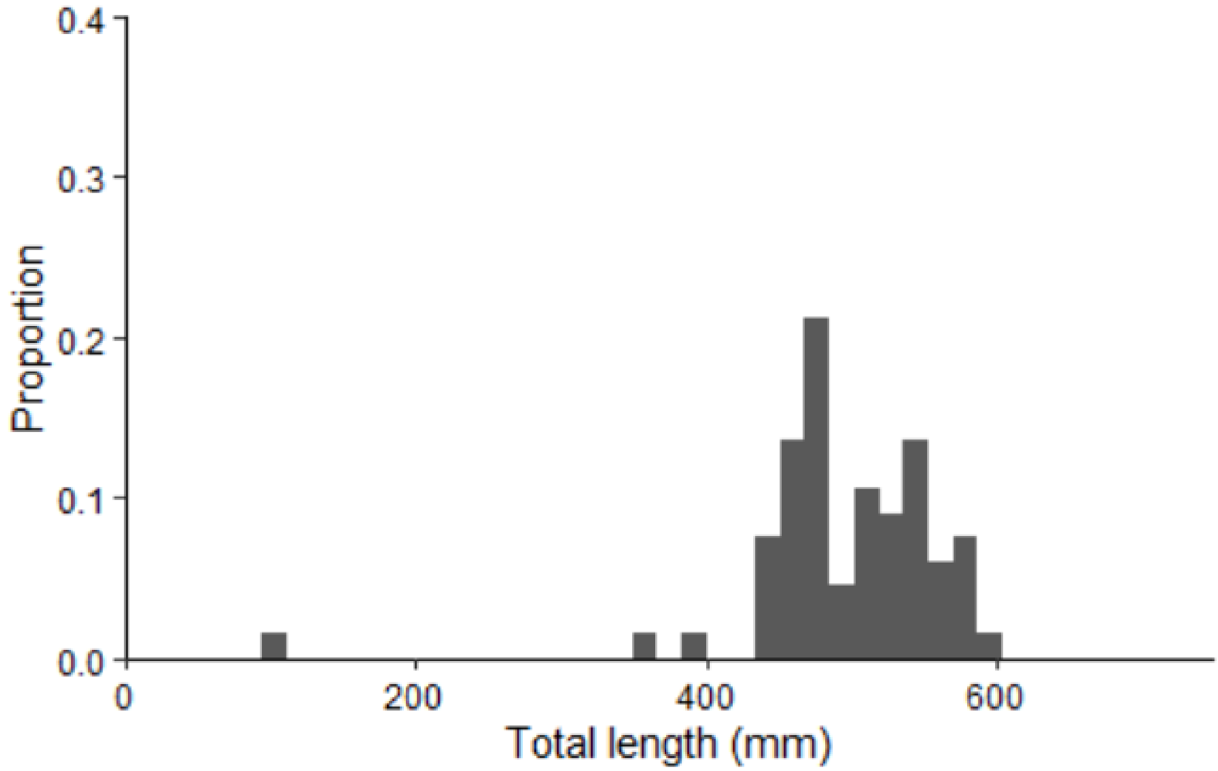

Figure 17. Proportional length frequency of Largescale Sucker captured using all gear types during the Arrowrock Reservoir lowland lake survey in July 2019.

DEADWOOD RESERVOIR

ABSTRACT

Kokanee Salmon *Oncorhynchus nerka* provide recreational fisheries and a prey base for piscivores in many waters of the western United States. The fishery at Deadwood Reservoir is supported primarily by kokanee and other salmonids that may prey on kokanee to reach large sizes. Additionally, this kokanee population has historically been Idaho's primary egg source to produce hatchery kokanee of early run strain. Kokanee escapement has been managed annually since 2010 to regulate fish densities and meet egg collection goals for hatchery stocking of other kokanee fisheries, while still providing desirable sizes for the sport fishery. Gill netting is important for setting escapement targets and monitoring the effectiveness of management strategies. In 2019, kokanee gill net CPUE was 23.2 fish/net night.

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INTRODUCTION

Deadwood Reservoir's kokanee population serves as Idaho's primary egg source for producing hatchery-reared early spawning kokanee. Historically, this population has provided up to 7 million eggs to Idaho Department of Fish & Game (IDFG) hatcheries. On years when egg collection goals have been met, resultant fry and fingerlings have been distributed to 15-20 waters statewide. However, because their life cycle is so short, kokanee populations are well known for having highly fluctuating densities and as a result, their growth rates are highly density dependent. Density-dependent growth results in decreased mean length at maturity at increased densities and is common in kokanee populations (Rieman and Myers 1992; Rieman and Maiolie 1995). Wide fluctuations in kokanee density have been especially evident at Deadwood Reservoir, resulting in fluctuating levels of angling effort. The reservoir also supports low densities of piscivores that have historically had little impact on kokanee abundance.

Additionally, Deadwood Reservoir has historically had as many as five tributaries with spawning habitat. From 2006 to 2011, IDFG sought to reduce kokanee abundance and increase mean length by limiting escapement into a number of the Deadwood Reservoir tributaries (Kozfkay et al. 2010). High flow events that washed out the picket weirs and access restrictions due to forest fires contributed to the variable success of these efforts. However, efforts were considered successful in most years. Subsequent periodic monitoring of these tributaries has indicated little to no kokanee spawning. In addition, continued restricted escapement above the Deadwood weir also helped limit production. However, these restrictions were too effective in limiting kokanee production as kokanee numbers dropped below a level satisfactory to meet statewide early-run egg needs from 2015 to 2017. Fortunately, numbers have begun to rebound and minimum egg needs were again met in 2018.

Egg collection efforts at Deadwood Reservoir were discontinued in 2009 to evaluate the South Fork Boise River weir location. Due to limited success of the South Fork Boise River weir, egg collection and escapement management efforts resumed at Deadwood Reservoir in 2010 and continued through 2016. However, a continued downward trend in the Deadwood Reservoir kokanee population led to collection efforts on the Deadwood River being discontinued again in 2017 as the North Fork Clearwater River was evaluated as a potential alternative early run kokanee egg source. Again, limited success resulted in egg take at Deadwood Reservoir resuming in 2018.

Estimates of kokanee angling effort and corresponding potential harvest impacts have long been anecdotal at Deadwood. However, with recent declines in kokanee numbers and the corresponding increase in kokanee size, managers were concerned that the combination of large kokanee and liberal bag limits (25 fish per day) were resulting in a high level of overall angler harvest in the Deadwood fishery, further impacting subsequent egg take. A creel survey was conducted in 2018, and management recommendations resulted in reduced bag limits in 2019.

Our objectives for this work were to continue to contribute annual gillnet catch data to a predictive model to help inform spawning operations and egg take goals at Deadwood Reservoir, thus providing early-run kokanee for anglers across the state of Idaho.

STUDY AREA

Deadwood Reservoir is a 1,260-ha impoundment located on the Deadwood River in Valley County, approximately 40 km southeast of Cascade, Idaho and 85 km northeast of Boise, Idaho Completed in 1931, the reservoir offers a scenic setting at a relatively high elevation (1,615 m above sea level), and is a popular destination for many during summer. Deadwood Reservoir offers abundant sport fishing opportunities for kokanee, resident fall Chinook Salmon *Oncorhynchus tshawytscha*, Rainbow Trout *Oncorhynchus mykiss,* and Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi*. Bull Trout *Salvelinus confluentus* are present, but at a very low abundance.

METHODS

The pelagic fish species composition in Deadwood Reservoir was assessed using six curtain gill nets set over two nights at three separate locations (six total net nights; Figure 14). At each site, two nets were suspended at offsetting depths in the water column with focus on the "kokanee layer"; one net from 3 to 6 m and one from 6 to 9 m. Nets were 55-m wide x 3-m deep and made up of 18 separate, 3-m wide panels comprised of 13-, 19-, 25-, 38-, 51-, 64-, 76-, 89-, and 102-mm stretch mesh. The nine various sized panels were each repeated twice, randomly, throughout the length of the net.

Captured fish were identified to species and measured for total length (± 1 mm). Kokanee greater than 150 mm were necropsied to determine sex, maturity, fecundity, and to assess mean length of females during the spawning run. Catch data were summarized as the number of fish caught per unit of effort (CPUE; fish/net night). All kokanee otoliths were removed for determining age using sectioned whole otoliths. Otoliths were aged by two agers and discrepancies between agers were settled via discussion and image review among agers and the aid of fish length.

Based on results from the early summer gillnet surveys, IDFG has developed a model to predict relationships in gillnet survey data and subsequent annual weir returns. Model inputs include CPUE of adults and associated size of mature females. Model outputs include estimated growth and ultimately fecundity of females, as well as the predicted annual weir returns. IDFG uses this model to not only monitor egg take goals, but to estimate escapement to the Deadwood River to supplement naturally-reproducing kokanee populations.

RESULTS

A total of 177 fish were captured in gill nets during the pelagic survey (Table 7). Approximately 78% of the catch was kokanee (n = 139, CPUE = 23.2 fish/net night), followed by Mountain Whitefish *Prosopium williamsoni* (18%, n = 32, CPUE = 5.3 fish/net night). Rainbow Trout were also captured, but in very low numbers (4%, n = 6, CPUE = 1.0 fish/net night).

Total length of kokanee captured in the gill nets ranged from 65 to 342 mm (mean = 213 mm, n = 139). Total length of Mountain Whitefish ranged from 156 to 405 mm (mean = 350 mm, n = 32). Total length of Rainbow Trout ranged from 340 to 415 mm (mean = 377 mm, n = 6; Figures 15 - 17).

Average size of mature female kokanee was 268 mm. At the time of the gillnet survey, it was difficult to determine mature males, and thus will not be included in this analysis. Kokanee captured in gill nets were ages 1-3 (Figure 18). No age-0 fish were captured in the gillnet survey. Age-specific CPUE of kokanee in 2019 was 5.2 fish/net night for age-1, 11.8 fish/net night for age-2, and 3.0 fish/net night for age-3. CPUE of spawning-age adult fish (age-2 and age-3) was 21 fish/net night. The estimated adult return to the Deadwood weir based off gill net catch was approximately 21,000 kokanee (Figure 18).

Age-1 kokanee ranged from 67 to 130 mm, age-2 kokanee ranged from 215 to 281 mm and age-3 kokanee ranged from 286 to 340 mm. With length-at-age data, we were able to fit a von Bertalanffy growth function (VBGF) to estimate hypothetical maximum age and hypothetical maximum length of Deadwood Reservoir kokanee (Figure 19). Based on the VBGF, the maximum hypothetical length for Deadwood Reservoir kokanee is approximately 372 mm and the hypothetical maximum age is age-5.

DISCUSSION

Based on recent gillnet surveys, the kokanee population in Deadwood Reservoir appears to be rebounding following the low numbers observed in 2017. Kokanee CPUE was 23.2 fish/net night in 2019 which was four times higher than the lowest CPUE observed in 2016. We currently have five years (2013, 2015, 2016, 2018 and 2019; 2014 catch was under-representative due to alternative net locations and 2017 there was no weir) of net and catch data. However, each additional year of netting data helps inform the model and increases the accuracy of the model predictions. Based on the available five years of data, the model predicts a relatively strong relationship that can serve as a predictor of weir returns based on age 2 and 3 gill net catch. Based on age-specific catch, the higher CPUE of age-2 kokanee in gill nets is promising for the 2020 spawn year. Additionally, the reservoir has been stocked with hatchery fingerling kokanee since 2018 to help the population recover more quickly. Continuation of early summer netting when the lake becomes accessible will provide insight into spawning kokanee abundance and aid in egg take and adult spawner escapement strategy in the future.

Deadwood Reservoir is increasing in popularity as a sport fishery, especially among anglers targeting kokanee. Despite the reservoir's remoteness, liberal bag limits and recent larger–than-average sized adult kokanee have made this fishery even more popular among kokanee anglers in recent years. Given the increase in popularity and significant harvest impact, IDFG suggested reducing the daily kokanee bag limit to 15 fish (resulting in a 45-fish possession limit) starting in 2019. Based on trip duration and possession limits, we estimated this bag reduction would reduce adult kokanee harvest by roughly 20% while still providing a liberal enough limit to encourage anglers to make the long trip to Deadwood. This proposed rule change was adopted by the Commission and took effect in 2019. We did not evaluate the effect of this rule change with a formal creel study.

Management of the kokanee population in Deadwood Reservoir remains difficult given the numerous goals associated with the population. Our desire is to manage for a population that is abundant enough to provide adequate juvenile kokanee prey for the growth of trophy-sized trout and salmon, but not so abundant that adult kokanee size is reduced enough to discourage kokanee anglers or reduce the efficiency of an egg take. Given our current knowledge of the density dependent growth relationship at Deadwood, a target female length of about 305 mm is likely ideal in achieving our management goals. Based on the VBGF, the maximum hypothetical length for Deadwood Reservoir is approximately 372 mm, so a target length of 305 mm is possible.

Deadwood Reservoir is the primary source for early-run kokanee, a highly desired sportfish in Idaho. As such, the ability to predict spawning returns in Deadwood Reservoir is paramount not only for Deadwood Reservoir, but all early-run kokanee fisheries in Idaho. However, managing kokanee abundance in a highly productive system with multiple spawning tributaries, such as Deadwood, remains difficult and we recognize the population will continue to fluctuate around specific goals. We will continue to monitor the kokanee population in Deadwood Reservoir into the future.

RECOMMENDATIONS

1. Continue monitoring the kokanee population in Deadwood Reservoir with gill nets to sample pre-spawning fish and generate age-specific CPUE and length-at-age to estimate potential spawners in 2020.

2. Stock hatchery fingerling kokanee in Deadwood Reservoir in June 2020.

3. Assist in weir operations on the Deadwood River to manage escapement and collect broodstock for egg collection.

4. Monitor escapement in other Deadwood Reservoir tributaries (besides Deadwood River) by walking tributaries during the kokanee spawn.

Table 7. Species, total catch (*n*) and catch per unit effort (CPUE; fish/net) in six gill nets set in Deadwood Reservoirin June 2019.

Species	n	CPUE
Kokanee	139	23.2
Mountain Whitefish	32	5.3
Rainbow Trout	6	1
Total	177	29.5

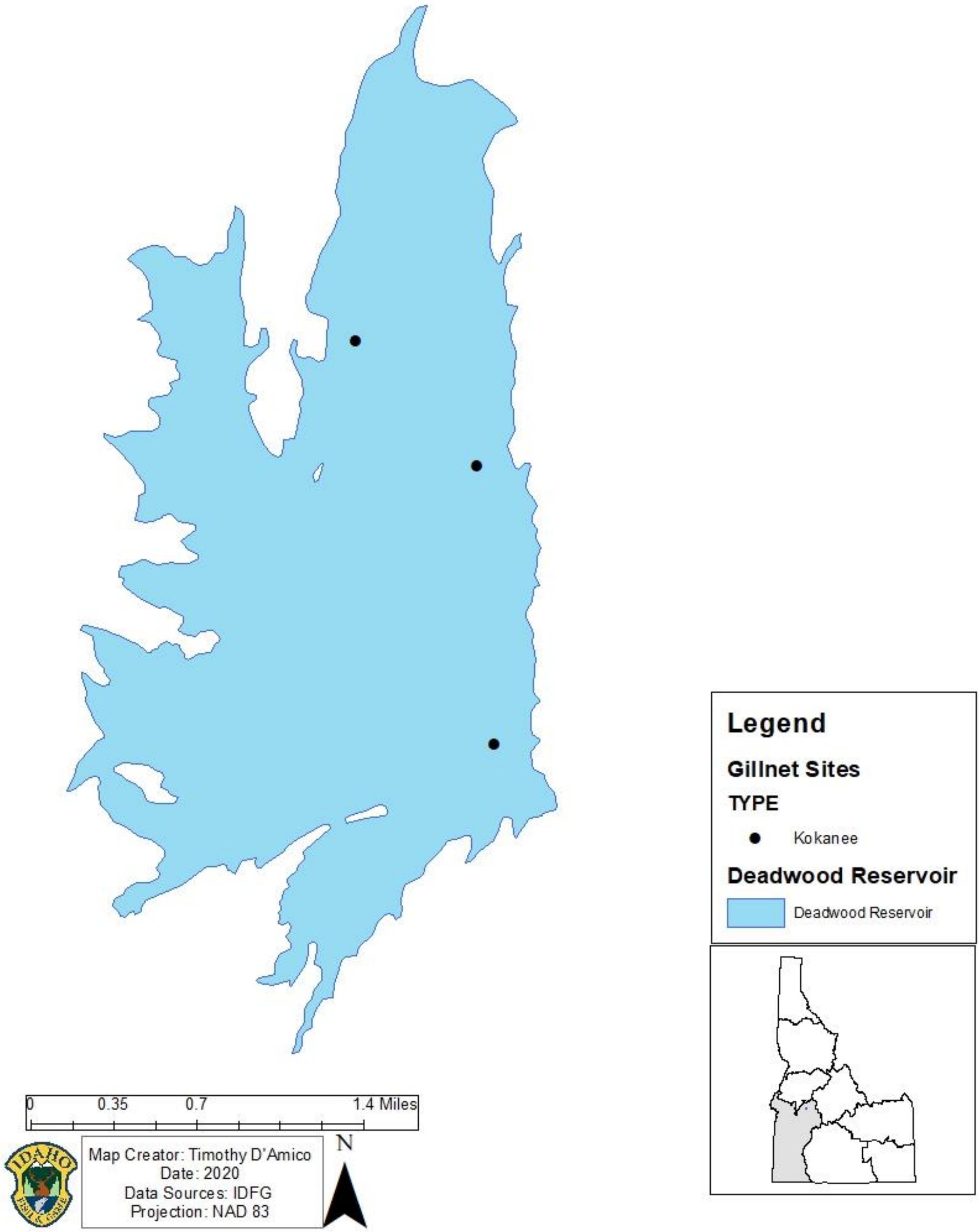

Figure 18. Locations of curtain gillnet sets in Deadwood Reservoir, Idaho in June 2019.

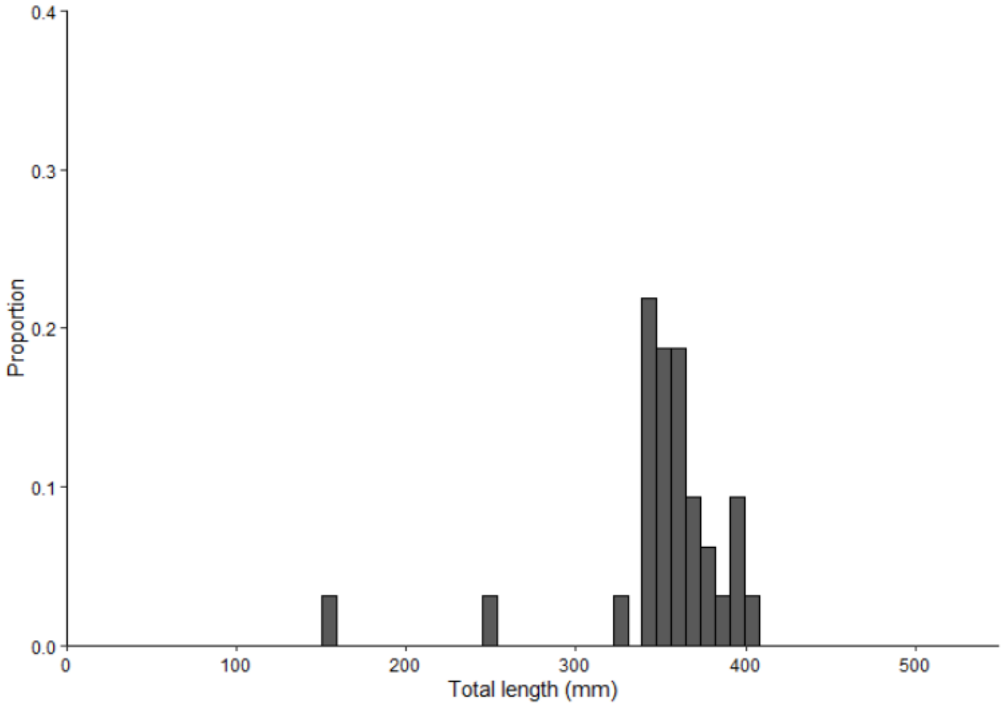

Figure 19. Proportional length frequency histograms for Mountain Whitefish caught in curtain gillnets in Deadwood Reservoir in June 2019.

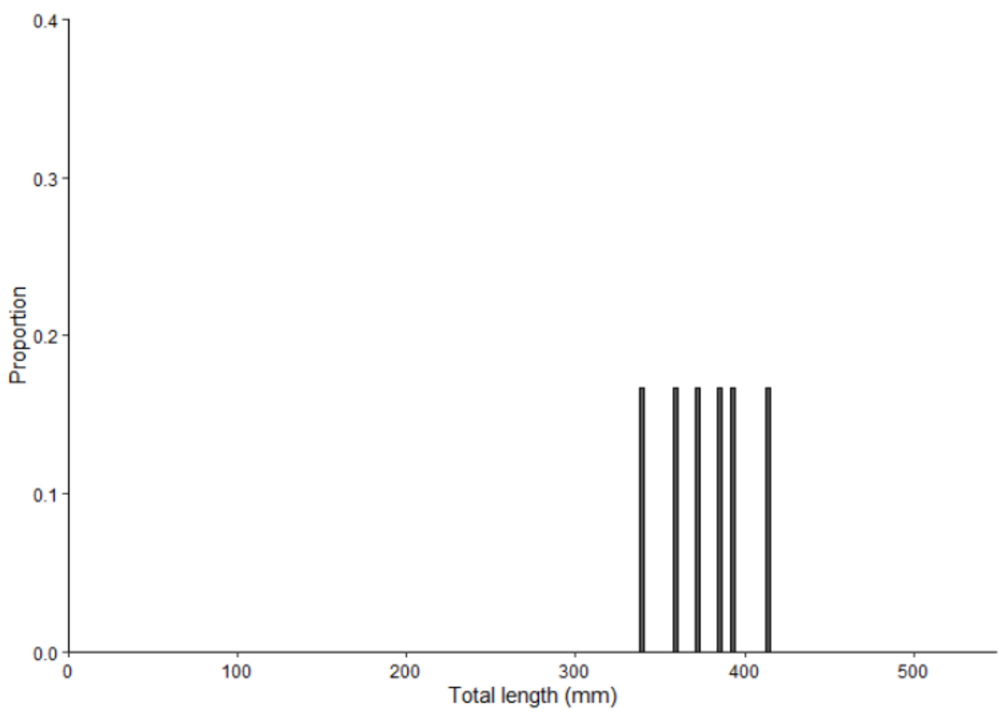

Figure 20. Proportional length frequency histograms for Rainbow Trout caught in curtain gillnets in Deadwood Reservoir in June 2019.

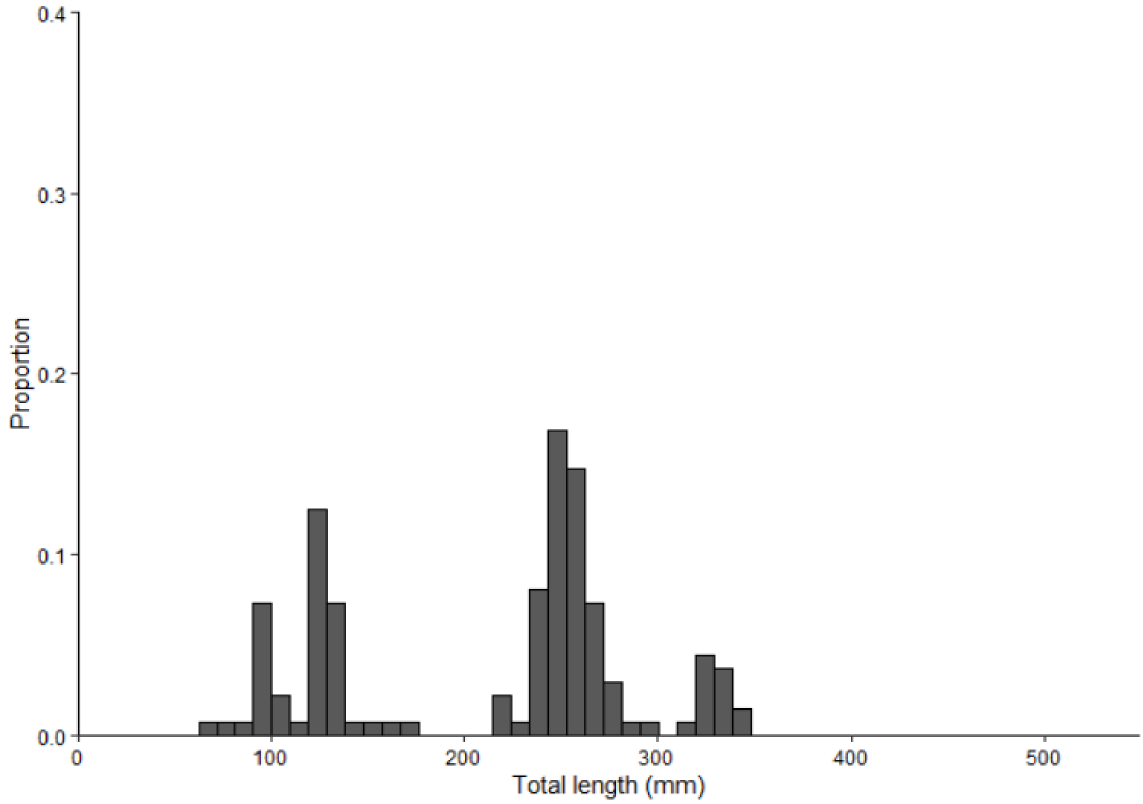

Figure 21. Proportional length frequency histograms for kokanee caught in curtain gillnets in Deadwood Reservoir in June 2019.

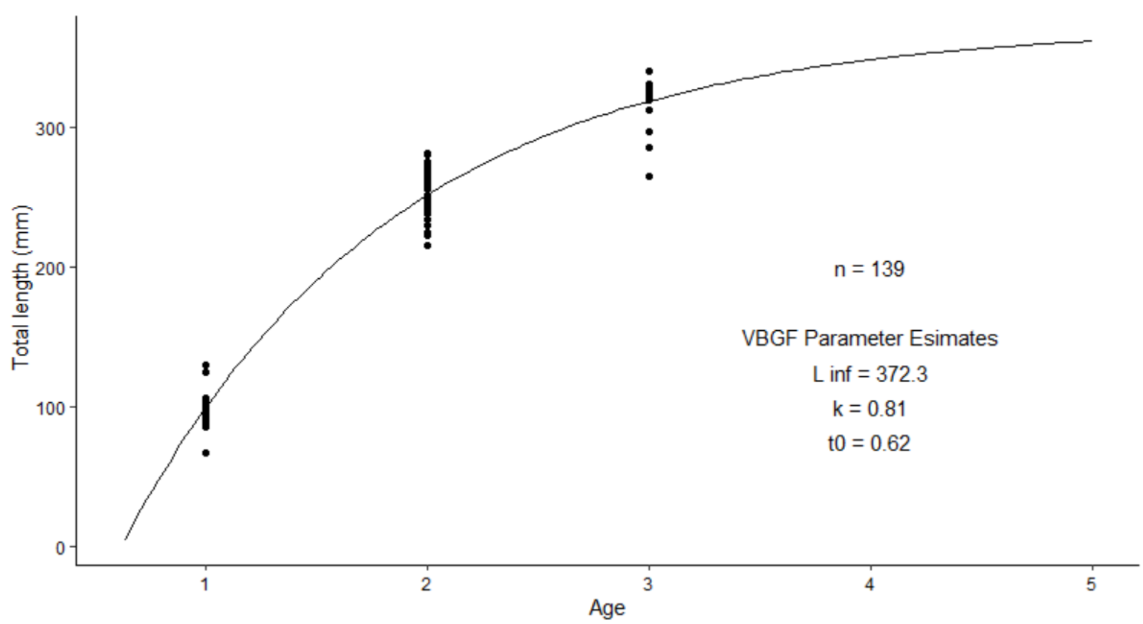

Figure 22. Length-at-age and estimated von Bertalanffy growth function parameters of kokanee sampled by curtain gillnets in Deadwood Reservoir in June 2019.

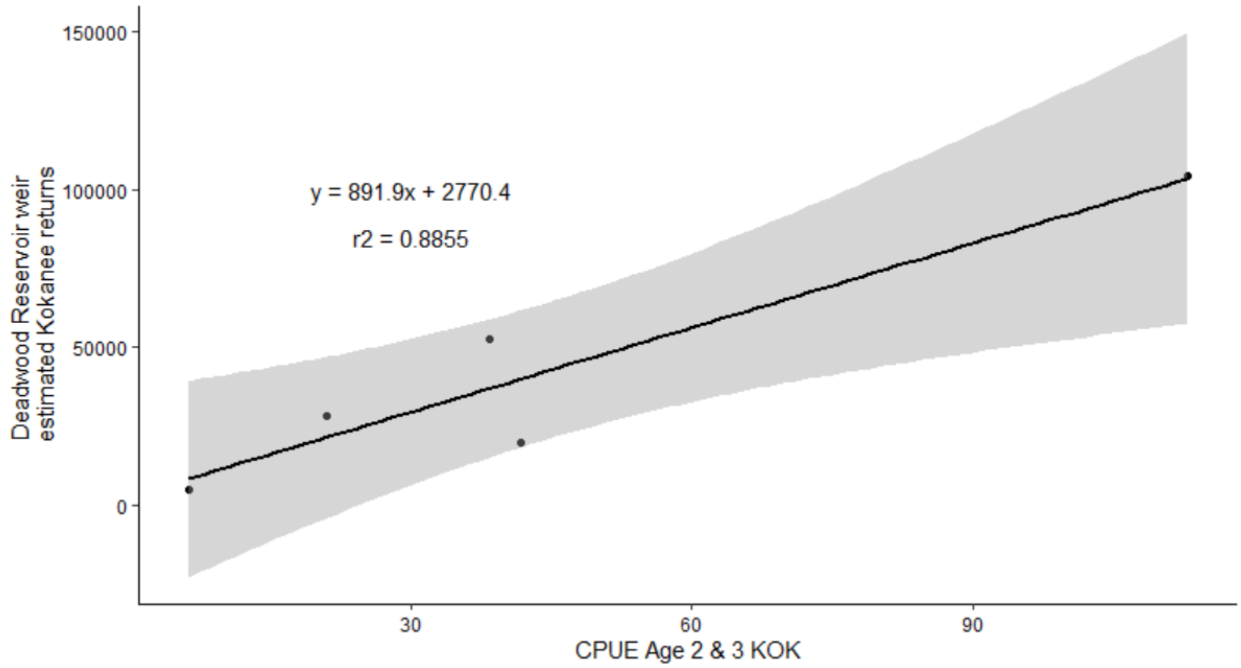

Figure 23. Deadwood Reservoir weir estimated kokanee returns as a function of CPUE of age-2 and age-3 adult kokanee for curtain gillnet surveys conducted in June 2013, 2015, 2016, 2018 and 2019.

CRANE CREEK RESERVOIR

ABSTRACT

Crane Creek Reservoir was most recently sampled in 2008. As part of ongoing quasi-systematic sampling of regional fisheries, we conducted a standard lowland lake survey on Crane Creek Reservoir on July 2, 2019. Sampling efforts followed protocol from previous standard Crane Creek Reservoir lowland lake surveys conducted in 1995, 1998, 2001, and 2008. The 2019 survey resulted in 17 Bluegill *Lepomis macrochirus*, 5 Bridgelip Sucker *Catostomus columbianus*, 468 Brown Bullhead *Ameiurus nebulosus*, 63 Channel Catfish *Ictalurus punctatus*, 45 Common Carp *Cyprinus carpio*, 137 Crappie *Pomoxis spp.*, 3 Largemouth Bass *Micropterus salmoides*, 2 Pumpkinseed *Lepomis gibbosus*, and 1 Speckled Dace *Rhinichthys osculus* being sampled. Bluegill, Bridgelip Sucker, Largemouth Bass, Pumpkinseed, and Dace accounted for less than 3% of the total fish sampled. Relative weight suggested near-normal body condition for all measured species and low PSD for all species indicates populations strongly skewed towards smaller fish. Total catch per unit effort (CPUE) and weight per unit effort (WPUE) were 267 and 26, respectively, which were lower than previous sampling. Additionally, out of three pairs of gill nets deployed (one floating and one sinking net per pair), zero fish were captured in the three sinking gill nets. Continued routine monitoring of this fishery will be important to further inform future management decisions.

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INTRODUCTION

Crane Creek Reservoir is a 937-ha irrigation reservoir that impounds North, South, and main-stem Crane as well as Hog and Milk creeks. The dam is located approximately 20 km upstream from the confluence of Crane Creek and the Weiser River, which is about 34 kilometers east of Weiser, ID. Crane Creek Reservoir lies at 973 msl. As an irrigation reservoir, water levels at Crane Creek Reservoir fluctuate throughout the year. Kozfkay et al. (2008) found that seasonal reservoir drawdowns, high turbidity, and remoteness keep fishing pressure to a low level. In 2007, the Idaho State Department of Agriculture extensively studied the water quality of Crane Creek Reservoir and its outlet. Previous reports had indicated suspended clay particles nutrient loading greatly reduced water quality and negatively impacted aquatic life. However, these 2007 studies suggested the clay particles were too small to create a negative impact and nutrient levels were acceptable. Since the 2007 investigation, water quality in Crane Creek Reservoir has been classified as "good" (EPA, 2020).

Crane Creek Reservoir has been managed under the Idaho Fish and Game Department's (IDFG) general fishing regulations of six trout and six bass (none under 12") with no size or bag limits on other species. Crane Creek Reservoir has records for only eight official stocking events: four warm-water fish introductions between 1967 and 1990 (Largemouth Bass, crappies, and Channel Catfish), and four stockings of Lahontan Cutthroat Trout (1990-1992). Subsequent sampling has indicated that these Lahontan Cutthroat stockings were largely unsuccessful. Most game species have historically maintained sustainable populations and Crane Creek Reservoir has previously been used as a source population of crappies to supplement other fisheries (Paul Jansen, personal communication 2020). Crane Creek Reservoir is a popular fishing spot for locals and has produced state-record crappies in 2007 and again in 2012.

METHODS

Fish populations in Crane Creek Reservoir were sampled with standard IDFG lowland lake sampling gears on July 2, 2019. Sampling gear included paired gill nets, trap nets, and night electrofishing. Paired gill net sets included floating and sinking monofilament experimental nets, 46-m wide x 2-m deep, with six incremental panels composed of 19-, 25-, 32-, 38-, 51-, and 64-mm bar mesh. One floating and one sinking net, fished for one night, equaled one unit of gill net effort. Trap nets possessed 15-m leads, 1-m x 2-m frames, crowfoot throats on the first and third of five loops, 19-mm bar mesh, and had been treated with black tar. One trap net fished for one night equaled one unit of trap net effort. For boat electrofishing effort, pulsed direct current was produced by a 5,000-watt generator. Frequency was set at 120 pulses per second and a pulse width of 40, which yielded an output of 5-6 amps. One hour of active on-time electrofishing equaled one unit of effort. In total, four trap net, three gill net, and one electrofishing units, composed of three 1,200 second sub-samples, were utilized (Figure 20).

Captured fish were identified to species, measured for total length (±1 mm), and weighed to the nearest gram with a digital scale. Fish lengths and weights were used to develop length-weight relationships, which allowed us to estimate weights for fish that were not weighed in the field. Estimated weights based on these relationships provided a more robust dataset to evaluate the fisheries. Proportional stock densities (PSD) were calculated for gamefish populations (Anderson and Neuman 1996) to describe length-frequency data. PSD values are based on the proportion of quality size fish in a given waterbody and use standardized and species-specific length groups. Relative weight (W_r) was calculated as an index of general fish body condition where a value of 100 is considered average (Blackwell et al. 2000). Values greater than 100 describe abundant food sources and healthy fish, whereas values less than 100 indicate less than ideal foraging conditions. Catch-per-unit-effort (CPUE) and weight-per-unit-effort (WPUE) in kg were calculated by standardizing the catch of each gear type to one unit of effort and then summing across the three gear types.

RESULTS

A total of 741 fish were collected from Crane Creek Reservoir in 2019, including 17 Bluegill, 5 Bridgelip Sucker, 468 Brown Bullhead, 63 Channel Catfish, 45 Common Carp, 137 Crappies, 3 Largemouth Bass, 2 Pumpkinseed, and 1 Speckled Dace. Trap nets yielded the highest CPUE at 145 as well as the highest number of total fish (581), followed by electrofishing (102), and gill nets (19; Table 9). Total WPUE was 26.1 kg, with electrofishing having the highest WPUE (13.6 kg), followed by trap nets (7.7 kg), and gill nets (4.7 kg; Table 10). Additionally, with the three pairs of gill nets deployed, all of the fish were caught in floating nets – no fish were captured in sinking gill nets.

Brown Bullhead was the most common fish and comprised 63% of the total number of fish caught (CPUE = 124). Of the 468 total Brown Bullhead, 454 were caught in trap nets, nine by electrofishing, and five in gill nets. Brown Bullhead total length ranged from 146 to 238 mm (Figure 21). PSD was 1.4, indicating a population strongly skewed toward small fish. However, a mean relative weight of 106 indicates higher than average body condition. Brown Bullhead WPUE was low (4.1), and they only accounted for 15.6% of the total biomass.

Crappies were the second most common fish and comprised 18% of the total number of fish caught (CPUE = 62). Of the 137 Crappies, 73 were caught in trap nets, 33 by electrofishing, and 31 in gill nets. Mean relative weight for Crappies was 114, suggesting above average body condition. Crappie lengths ranged from 126 to 401 mm (Figure 22) with a PSD of 25, calculated from 136 stock length fish (≥130 mm) and 34 quality length fish (≥200 mm). This low PSD indicates a population skewed towards smaller fish. Crappies also had a low WPUE (3.4) and only accounted for 13.1% of total biomass.

Channel Catfish accounted for 9% of the total catch and 29.6% of the total biomass. Channel Catfish had a CPUE of 26 with 63 total fish, most of which were caught in trap nets (39). Mean relative weight for Channel Catfish was 94, suggesting near normal body condition. Channel Catfish lengths ranged from 168 to 561 mm (Figure 23) with a PSD of 14, calculated from 44 stock length fish (≥280 mm) and 6 quality length fish (≥410 mm), indicating a population skewed towards smaller fish.

Common Carp accounted for 6% of the total catch and 37.9% of the total biomass. Common Carp had a CPUE of 35 with 45 total fish, most of which were caught by electrofishing (31). Mean relative weight for Common Carp was 84, suggesting below average body condition. Common Carp lengths ranged from 154 to 430 mm (Figure 24) with a PSD of 11, calculated from 27 stock length fish (≥280 mm) and 3 quality length fish (≥410 mm), indicating a population skewed towards smaller fish.

The remaining fish community represented a low percentage of total catch: Bluegill (2%), Bridgelip Sucker (1%), and Largemouth Bass, Pumpkinseed, and Speckled Dace combined for less than 1% of the total catch. Metrics were not calculated for these species due to small sample size.

DISCUSSION

Compared to previous standard lake surveys, the 2019 total CPUE data suggests declines in Crane Creek Reservoir total fish abundance. Species CPUE comparisons further illustrate changes in individual populations. From 2008 to 2019, total CPUE (electrofishing, gill netting, and trap netting CPUE combined) decreased for Crappies (413 in 2008, 62 in 2019), Common Carp (111 in 2008, 35 in 2019), and Channel Catfish (74 in 2008, 26 in 2019), yet increased for Brown Bullhead (17 in 2008, 124 in 2019; Figure 26). Kozfkay et al. (2008) suggested an inverse relationship between Channel Catfish and Brown Bullhead, whereas strong Channel Catfish populations would lead to declining Brown Bullhead populations. Common Carp populations in southwest Idaho are of concern due to high recruitment and fast growth. Common Carp in Crane Creek have remained stable from 1995-2008 (Kozfkay et al. 2008), but declined like most other fish species in 2019. Similar to previous surveys, Largemouth Bass numbers were extremely low, suggesting a sustainable population, though not capable of generating angling interest in Crane Creek Reservoir. Bluegill and Bridgelip Sucker numbers also remained low, yet consistent with the 2008 survey. Two Pumpkinseed and one Speckled Dace were caught in 2019, which is the first that either species has been documented in Crane Creek Reservoir.

Although fish numbers were low, mean relative weights were at or near 100 for all recorded species (Figure 27). These values indicate fish have suitable food sources and are healthy, and the 2019 crappie value (114) is consistent with the 2009 *Wr value* (116).

Low Crappie numbers in 2019 do not necessarily reflect a poor fishery in Crane Creek Reservoir. Crappies are characterized as “boom or bust” cyclic or quasi-cyclic fish species, where strong year-classes could potentially reduce growth and survival of a subsequent year class (Allen and Miranda 2001). In 2015, four trap nets and boat electrofishing was used to collect 1,150 crappies that were used to supplement a population in a nearby reservoir (Janssen and Allen 2015). Crappies were also collected from Crane Creek Reservoir for translocation efforts in 2014 and 2015 (Paul Jansen, personal communication), and similar harvest numbers indicate a stable population that suggests the low 2019 crappie numbers may be due to timing in cyclic “bust” period. Additionally, the 2019 survey resulted in one large, trophy-sized crappie, similar to the 2008 survey that found one large crappie that would have been a new state record at the time.

Prior to 2007, suspended sedimentation and elevated nutrient levels in Crane Creek Reservoir caused the EPA to classify the waterbody as “impaired,” indicating poor water quality. Extensive studies in 2007 resulted in water reclassification from “impaired” to “good”, which has been upheld in most recent EPA reports (EPA, 2020). However, during the 2019 lowland lake survey, no fish were captured in any of the three sinking gill nets, suggesting potential water quality issues in the benthic zone. Multiple studies suggest the absence of bottom dwelling fish species in the benthic zone may indicate hypoxic conditions caused by various environmental and anthropological factors, such as: (1) climatic warming can cause the lake thermocline to form near the bottom, reducing the hypolimnion volume and increasing the rate of oxygen depletion (Blumberg and Toto 1990), (2) nutrient loading from point- and non-point sources increases oxygen depletion (Schertzer and Sawchuk 1990), and (3) eutrophication, which can reduce and/or change prey species that may lead to smaller populations of stunted fish (Hayward and Margraf 1987). These conditions may help explain the low PSD and population numbers encountered in 2019.

Although the EPA's latest reports show that Crane Creek Reservoir water quality is "good," the 2019 survey results, combined with a reported fish kill in 2018, suggest there may be hypoxic conditions that are having negative impacts on resident fish communities. Further water quality tests should be completed to investigate potential reasons that no fish were found in the benthic zone and if contaminants are contributing to smaller, stunted fish populations.

RECOMMENDATIONS

1. Continue to monitor Largemouth Bass and Bluegill populations to determine if populations need to be supplemented.

2. Carefully consider whether Crane Creek Reservoir should be used as a source population for introductions of crappies to nearby waterbodies, until populations rebound to historical abundances.

3. Look for opportunities to reduce the Common Carp population.

Table 8. Species, catch and catch per unit effort (CPUE) for each gear type used during the Crane Creek Reservoir lowland lake survey, 2019.

Species	Electrofish catch	Electrofish CPUE	Gill net catch	Gill net CPUE	Trap net catch	Trap net CPUE	Total catch	**Total CPUE**
Bluegill	8	8	0	0	9	2	17	**10**
Bridgelip Sucker	3	3	0	0	2	1	5	**4**
Brown Bullhead	9	9	5	2	454	114	468	**124**
Channel Catfish	12	12	12	4	39	10	63	**26**
Common Carp	31	31	10	3	4	1	45	**35**
Crappies	33	33	31	10	73	18	137	**62**
Largemouth Bass	3	3	0	0	0	0	3	**3**
Pumpkinseed	2	2	0	0	0	0	2	**2**
Speckled Dace	1	1	0	0	0	0	1	**1**
Total	**102**	**102**	**58**	**19**	**581**	**145**	**741**	**267**

Table 9. Species, weight and weight per unit effort (CPUE) for each gear type used during the Crane Creek Reservoir lowland lake survey, 2019.

Species	Electrofish weight	Electrofish WPUE	Gill net weight	Gill net WPUE	Trap net weight	Trap net WPUE	Total weight	**Total WPUE**	% Biomass
Bluegill	0.3	0.3	0	0	0.6	0.1	0.9	**0.5**	1.7
Bridgelip Sucker	0.5	0.5	0	0	0.3	0.1	0.7	**0.6**	2.1
Brown Bullhead	0.9	0.9	0.4	0.1	12.2	3	13.5	**4.1**	15.6
Channel Catfish	2.8	2.8	7.9	2.6	9.3	2.3	20	**7.7**	29.6
Common Carp	8.5	8.5	3.4	1.1	1.1	0.3	12.9	**9.9**	37.9
Crappies	0.7	0.7	2.5	0.8	7.6	1.9	10.8	**3.4**	13.1
Total	**13.6**	**13.6**	**14.2**	**4.7**	**31**	**7.7**	**58.8**	**26.1**	**100**

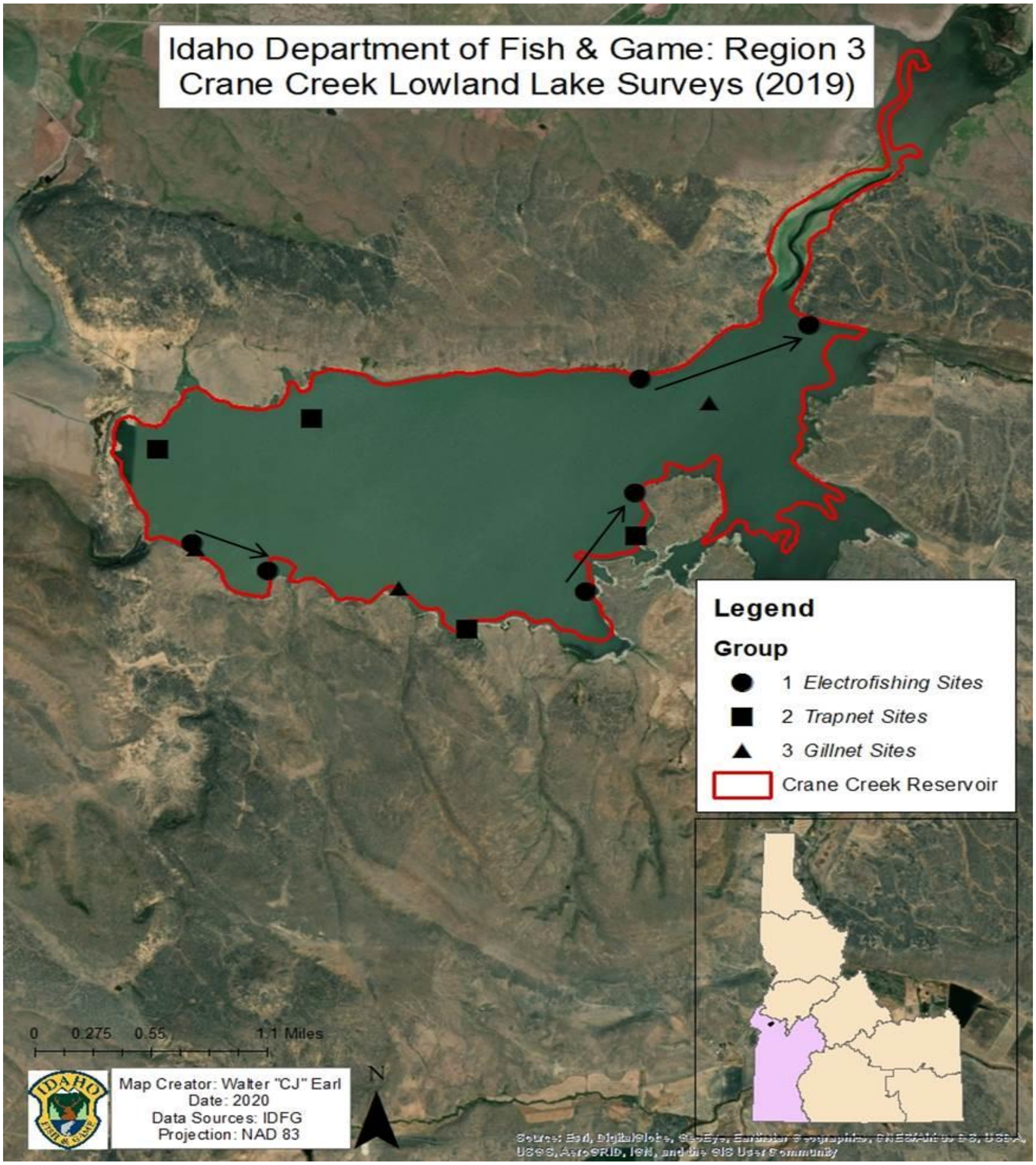

Figure 24. Map of Crane Creek Reservoir, Idaho with electrofishing, trap net, and gill net locations from surveys conducted in 2019. Arrows indicate electrofishing start points and direction of sampling.

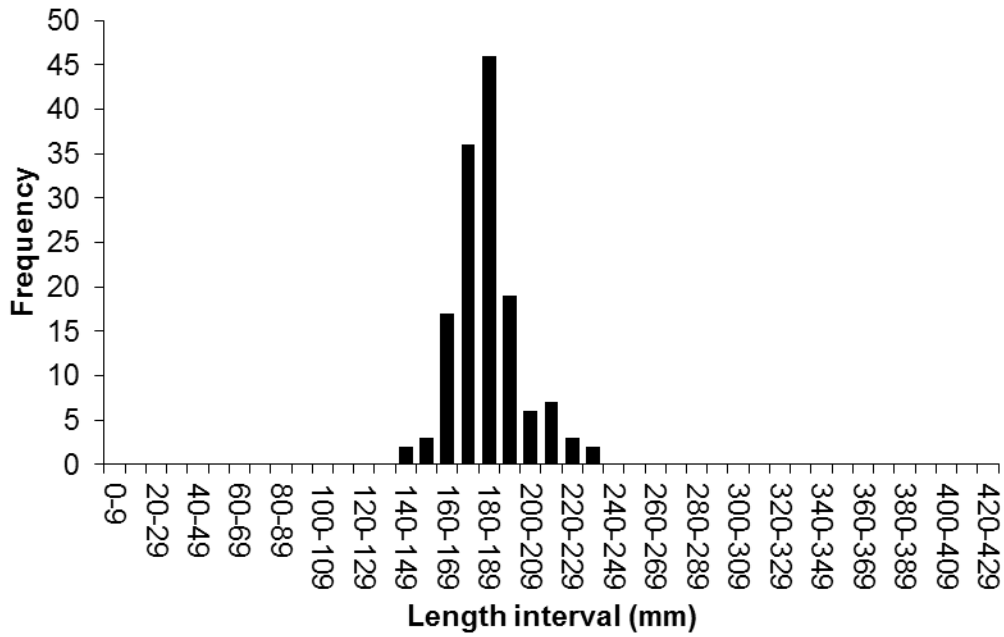

Figure 25. Length frequency of Brown Bullhead sampled with all gear types combined from Crane Creek Reservoir in 2019.

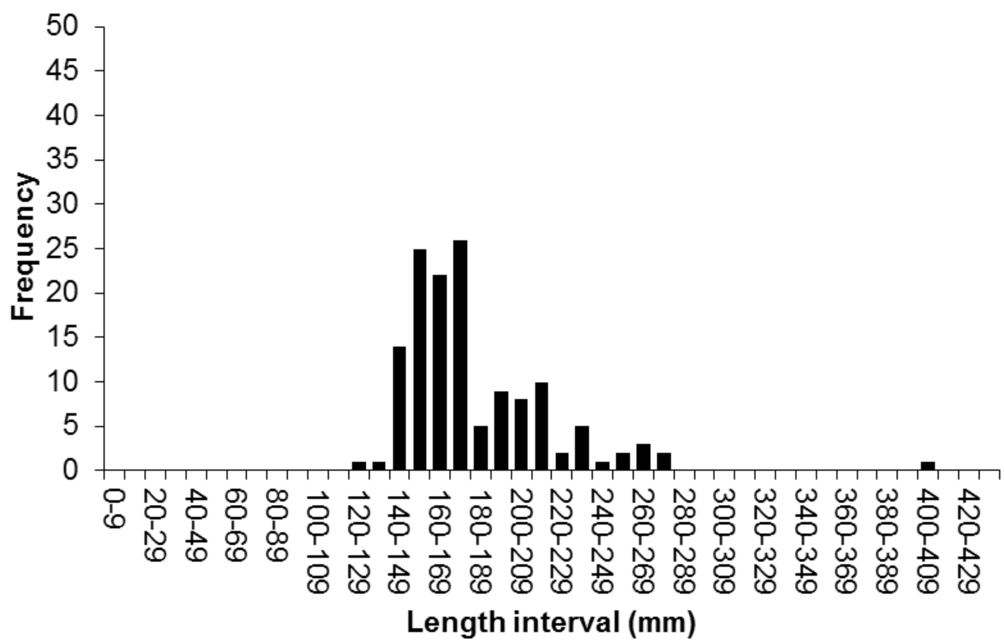

Figure 26. Length frequency of crappies sampled with all gear types combined from Crane Creek Reservoir in 2019.

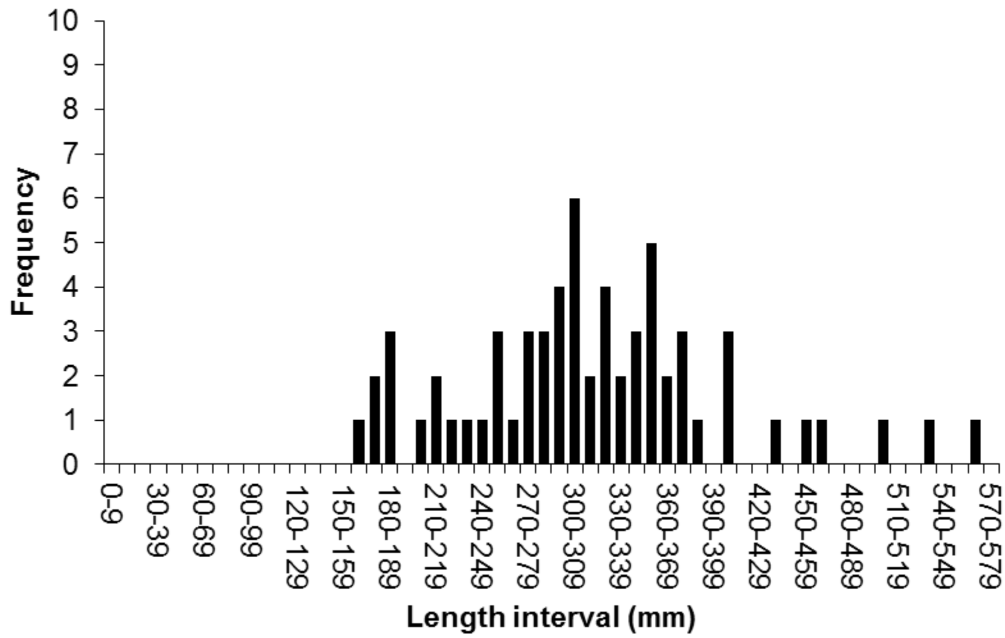

Figure 27. Length frequency of Channel Catfish sampled with all gear types combined from Crane Creek Reservoir in 2019.

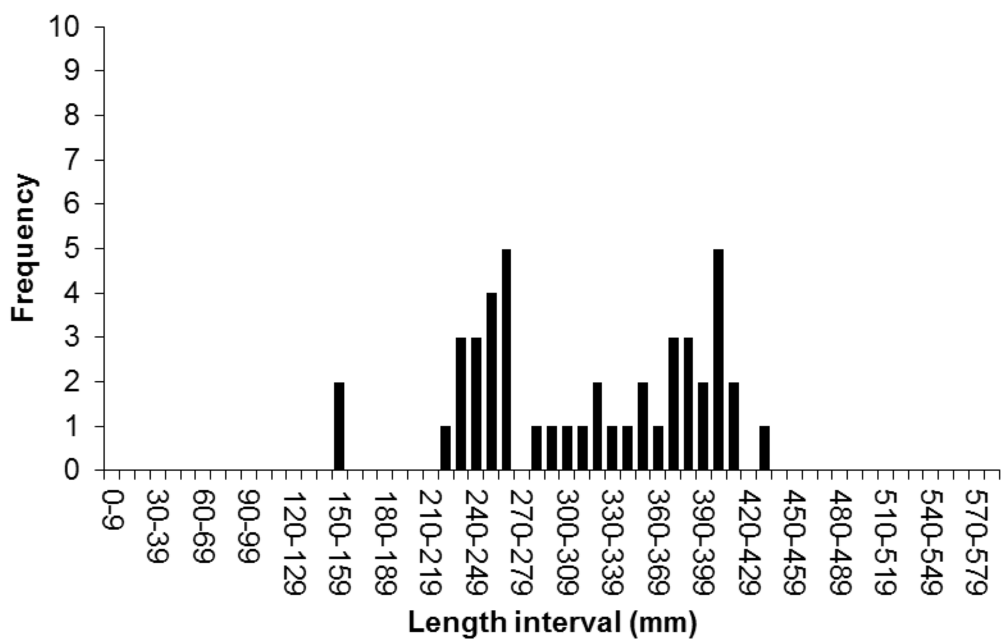

Figure 28. Length frequency of Common Carp sampled with all gear types combined from Crane Creek Reservoir in 2019.

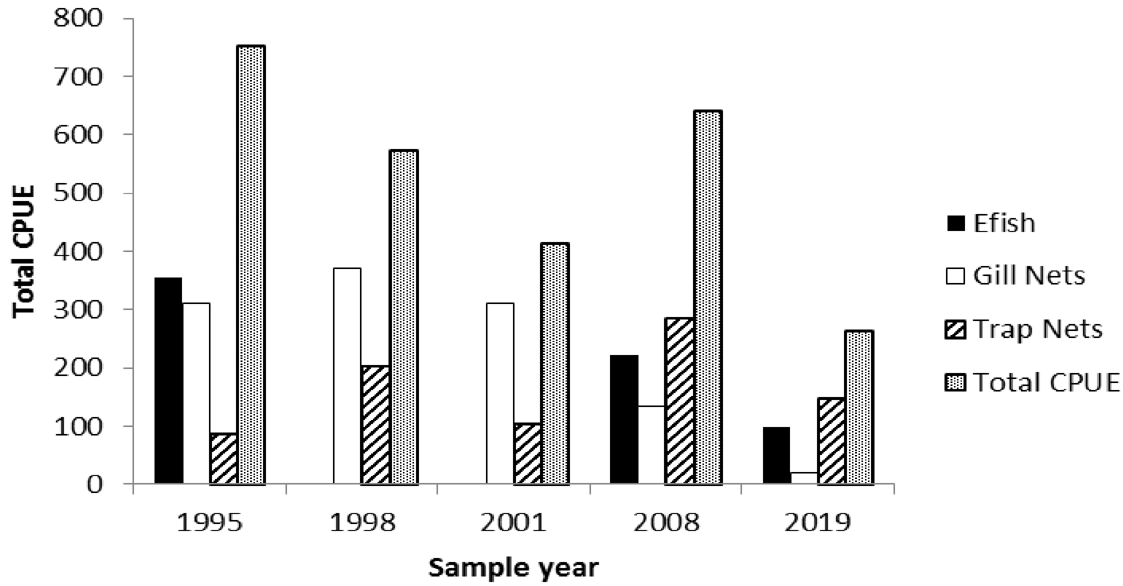

Figure 29. Comparison of Crane Creek Reservoir gear type-specific and total catch per unit effort (CPUE) for all survey years.

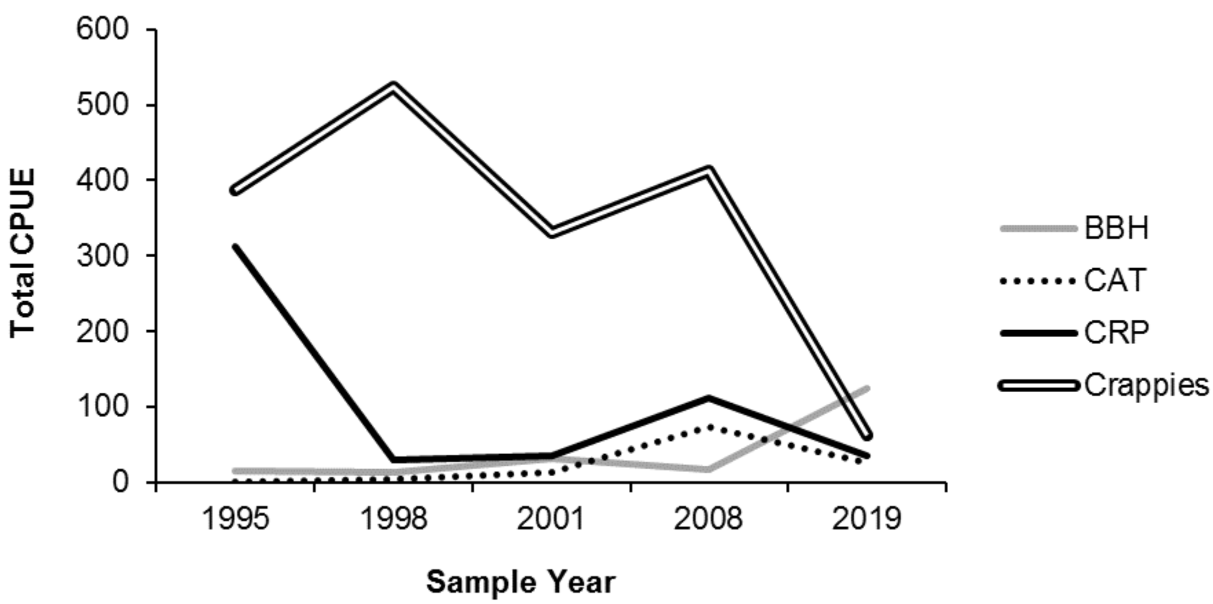

Figure 30. Comparison of catch per unit effort (CPUE) across multiple sample years of four common fish species in Crane Creek Reservoir.

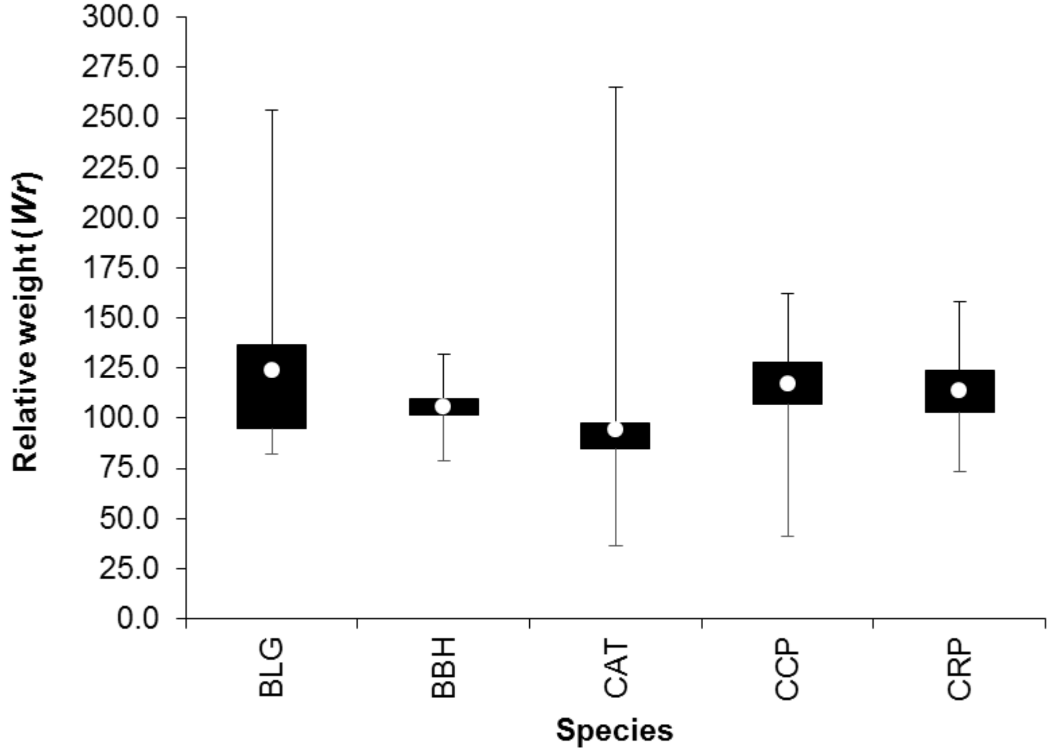

Figure 31. Comparison of relative weights (*Wr*) of fish species collected in Crane Creek Reservoir during the standard lowland lake survey, 2019. White circles represent average *Wr* recorded for each species.

ASSESSMENT OF PANFISH POPULATION DYNAMICS IN C.J. STRIKE RESERVOIR

ABSTRACT

Panfish species found in C.J. Strike Reservoir provide a very popular recreational angling opportunity in Southwest Idaho. In 2016, regional Idaho Department of Fish and Game staff began a multiyear investigation to better understand the population dynamics of crappie (Black Crappie *Pomoxis nigromaculatus*, White Crappie Pomoxis annularis, and their hybrids) and Yellow Perch *Perca flavescens*. We also endeavored to learn how anglers utilize these species in the fishery. In the spring and fall of 2019, our team completed surveys using standardized lowland lake sampling gears and index creel surveys to assess relative abundance of panfish species and angler use, similar to 2018. Continued monitoring of larval fish production was completed to identify peak larval mean densities for crappies and Yellow Perch. Otter trawl gear was used in the fall of 2019 to determine relative abundance of panfish species prior to winter. We interviewed 403 anglers during the creel surveys in spring and fall of 2019. Harvest rates increased for crappie from spring to fall of 2019. Peak larval crappie abundance was 89.91 fish/100m^3 which occurred on June 17, 2019. Spring crappie catch per unit effort (CPUE) was 48.67 fish/effort for all standardized gears, this value decreased to 10.15 fish/effort in the fall. Otter trawl survey catch was comprised of 39.70% crappie, 39.09% Yellow Perch and 18.18% Bluegill. Age and growth data were similar to data observed during the first two years of the assessment. Continued use of existing gear types and systematic sampling to develop indices of relative abundance should provide us with increased understanding of these sport fish populations.

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INTRODUCTION

Panfish (e.g. crappies Pomoxis spp., Yellow Perch *Perca flavescens* and Bluegill *Lepomis macrochirus*) commonly provide angling opportunity in many Idaho waters. One of the most popular and robust fisheries for panfish in southwestern Idaho is at C.J. Strike Reservoir. According to creel data collected by Idaho Power Company between 1994 and 2009, anglers expended an average of 260,000 hours annually at this fishery, and most of this time was directed at panfish species (Brown et al. 2010).

Crappie populations have long been described as cyclic by managers, exhibiting wide fluctuations in both larval production and adult abundance (Langlois 1937; Miranda and Allen 2000). This pattern is evident in C.J. Strike Reservoir where these same two demographics fluctuate dramatically from one year to the next. In years when crappie are abundant, the proportion of anglers targeting this species may more than double (Brown et al. 2010). A large year-class of crappie was produced in 2006, documented by the high larval densities observed in the Bruneau River arm of the reservoir. These larval crappies survived at a high rate but were not sampled again in a meaningful way until 2009 when they were large enough to be susceptible to adult sampling gear. Electrofishing catch-per-unit-effort (CPUE) for Black Crappie *Pomoxis nigramaculatus* during the 2009 lowland lake survey was 23 times higher than the highest observed CPUE from the five previous year's surveys (1995-2000; Butts et al. 2011). This year-class provided substantial fisheries in 2008, 2009 and later, although creel data was not collected after 2009 (Brown et al. 2010). This 2006 year-class declined in abundance after 2010 and no major year classes contributed to the fishery again until 2017, despite occasionally high larval production.

Yellow Perch populations seem to follow similar cyclic patters as crappie (Dembkowski et al. 2016). Past creel survey data at C.J. Strike indicated that the contribution of Yellow Perch to overall harvest ranges from a high of 40% (Allen et al. 1995) to a low of 3% (Flatter et al. 2003). Similar fluctuations have been observed in electrofishing CPUE conducted by Idaho Department of Fish and Game (IDFG) which ranged from a low of 1 to 159 fish/hour (Butts et al. 2011). Angler preference for Yellow Perch appears to vary across years as well; in the 1992 creel survey, anglers indicated that they targeted Yellow Perch roughly 10% of the time (Allen et al. 1995). Conversely, in a survey conducted by Idaho Power Company from 2007 to 2009, anglers targeted Yellow Perch 6 to 23% of the time. Currently, population dynamic information for Yellow Perch in C.J. Strike Reservoir is incomplete and no Yellow Perch focused studies have been completed.

Year-class strength for crappie and Yellow Perch may be determined at early life stages; whether this occurs before or after the first winter is currently unknown. A Neuston net has been towed at ten location on C.J. Strike from 2005 to 2016. This tool is more effective at sampling larval crappies rather than Yellow Perch and provides and index of relative abundance. Peak larval densities throughout this time period averaged 17 fish/100m^3 (10 year average; Butts et al. 2016). However, in 2006, densities averaged 58 fish/100m^3 and produced crappie in the fishery 2-4 years later. A statewide research project initiated in 2005 hypothesized that peak larval density would be a useful index for predicting year-class strength of crappie unless substantial over-winter mortality occurred. A previous project found no consistent relationship between the peak larval densities and year-class strength (Lamansky 2011), suggesting that other factors limiting early survival could be driving recruitment. Further investigation of larval production and subsequent survival is needed due to existence of these data gaps.

Data for age-1 and older crappie and Yellow Perch have been collected for the C.J. Strike Reservoir in the past, however life-stage specific mortality rates are lacking. Several lowland lake surveys conducted on C.J. Strike provided CPUE and length frequency data for these species (Butts et.al. 2011). However, life-stage mortality for crappie or Yellow Perch were not investigated. Meyer and Schill (2014), used no-reward tags to generate annual mortality rates for crappie, which ranged from 50-86% for the entire population (i.e. not year-class specific). Lamansky (2011) also investigated age and growth data for crappie populations throughout the state which included C.J. Strike Reservoir. Crappie sampled in C.J. Strike had relatively fast growth and very few crappie older than age-3 were observed. It is important to note that this study was conducted at a time when one year class dominated the population, preceded by several years of poor recruitment. Regardless, this and other studies suggest that most Idaho crappie populations exhibit (Meyer and Schill 2014). Age data for crappie collected in other Southwest Region waters suggest that crappie can survive to age six or older (Butts et al. 2013). Describing life-stage specific mortality rates may help identify population bottlenecks, which, if manageable, may increase recruitment of crappie or Yellow Perch for future fisheries.

Extensive research completed throughout the range of crappie have identified biotic factors such as size of spawning adults (Fayram et al. 2015; Bunnell et al. 2006), intraspecific and interspecific competition, as well as predation (Pope and Willis 1998; McKeown and Mooradian 2002; Parsons et al. 2004) as factors that affect recruitment. Abiotic factors such as water level (Sammons et al. 2002; Maceina 2003; Fayram et al. 2015), water temperature (Pine and Allen 2001; McCollum et al. 2003) and the physical and chemical characteristics of the waterbody (Bunnell et al. 2006) likely influence recruitment as well. Wisconsin's Department of Natural Resources recently released two relevant literature reviews that address management approaches for crappie and Yellow Perch based on biotic and abiotic factors (Fayram et al. 2015; Niebur et al. 2015) and implemented a 10-year strategic plan for managing panfish within the state (Hansen and Wolter 2016). A study in Missouri reservoirs found that multiple factors, both biotic and abiotic, likely add complexity to understanding crappie recruitment (Siepker and Michaletz 2013).

Currently, no bag or length limits have been placed on panfishes in C.J. Strike Reservoir and these populations are managed for maximizing harvest opportunity. However, the Southwest Region repeatedly received requests from anglers to implement restrictive regulations on crappie (most often a bag limit) with the hope of providing stable fishing opportunities on these cyclic fisheries. In other systems and states, biologists have studied the effects of restrictive regulations such as bag limits (Allen and Miranda 1995; Mosel et al. 2015) and minimum length limits (Isermann et al. 2002; Mosel et al. 2015) and suggested that natural mortality, angling mortality, and growth rates of a population need to be fully understood prior to deciding whether regulations changes are warranted. Minimum length limits have been shown to increase both abundance and size structure in crappie (Allen and Miranda 1995; Isermann et al. 2002; Mosel et al. 2015) and Yellow Perch (Mosel et al. 2015) populations. However, the benefits associated with bag limits of minimum length limits could be negated if the population exhibits slow growth and high natural mortality rates (Mosel et al. 2015, Isermann et al. 2002). Therefore, due to the lack of available growth and mortality data, informed decisions regarding restrictive fishing rules cannot currently be made. Prior to addressing the need for regulation changes (e.g. bag limit of minimum length requirement), data specific to C.J. Strike crappie and Yellow Perch need to be evaluated to predict whether these management tools can benefit sport fishing within the reservoir.

Lake and reservoir-specific studies are needed to better understand population fluctuation and the factors that affect panfish recruitment before appropriate management strategies can be applied (Lamansky 2011; Fayram et al. 2015). To advance management and determine whether regulations should be altered to maintain or improve crappie or Yellow Perch fisheries, an in-depth sampling of C.J. Strike Reservoir was implemented in 2016 to generate population-specific data, especially relating to abundance fluctuations. While the primary focus of this assessment is on crappie and Yellow Perch populations; when possible, data will also be collected for Smallmouth Bass *Micropterus dolomieu* and Bluegill to increase our understanding of these populations. The assessment includes an index creel survey in both spring and fall to learn how anglers utilize panfish species within the reservoir. The use of otter trawl gear was investigated to develop an index of relative abundance and monitor survival of larval production to the onset of winter. In 2017, spring and fall population indexing were initiated utilizing lowland lake survey gears (e.g. electrofishing, trap nets, and gill nets). Data generated from the spring relative abundance index will be used to assess whether overwinter mortality is a limiting factor that affects recruitment of young-of-year (YOY) crappie and Yellow Perch to future age classes. In addition, the data generated from the fall relative abundance index will allow us to identify whether larval fish survive to enter their first winter or if a survival bottleneck exists prior to fall. The spring and fall surveys also allow for the monitoring of older age classes of crappie and Yellow Perch at multiple life stages. Finally, zooplankton quality index (ZQI) sampling was established to determine whether zooplankton production affects panfish growth.

MANAGEMENT GOAL

Maintain or improve sport fishing opportunities for panfish species, specifically crappie species and Yellow Perch in C.J. Strike Reservoir, Idaho, through increased understanding of population dynamics and angler utilization.

OBJECTIVES

1. Identify optimal techniques (e.g. larval trawling, otter trawling, trap netting, gill netting, electrofishing) for monitoring primary panfish populations in C.J. Strike Reservoir at several life stages

2. Develop and implement annual, consistent monitoring efforts

3. Estimate key parameters that describe population dynamics of crappie and Yellow Perch, specifically, index of stock, length frequency, age frequency, age and growth, total mortality, fishing mortality, age and length at sexual maturity

4. Estimate key parameters that describe angler harvest of crappie and Yellow Perch

STUDY AREA

C.J. Strike Reservoir is primarily managed for hydroelectric power production. The reservoir experiences minimal water fluctuation throughout the year. Elevation of the reservoir is approximately 750 msl. The reservoir is geologically characterized as the Snake River plain, which consists of sedimentary and volcanic deposits. C.J. Strike Reservoir is listed as an impaired waterbody by the Idaho Department of Environmental Quality due to nutrient and pesticide inputs (IDEQ 2006). The reservoir is 3,035 ha and provides habitat for a wide variety of fish species ranging from cold-water species (e.g. White Sturgeon *Acipenser transmontanus* and Rainbow Trout *Oncorhynchus mykiss*) to warm-water species like crappie and Largemouth Bass *Micropterus salmoides*. C.J. Strike is influenced by two major water sources, the Snake and

Bruneau Rivers, and can be divided into three distinctive segments: the Bruneau Arm (1,123 ha), the Snake Arm (759 ha) and the Main Pool (1,153 ha). The Bruneau Arm is relatively shallow, warm, and turbid and typically has a low turnover rate from the much lower discharge contributed by the Bruneau River. The Snake Arm is deeper, clearer and has a high turnover rate.

METHODS

Site Selection

A randomized sampling protocol was implemented to collect representative samples of fish population throughout each section of the reservoir. Within each section, Google Earth Pro (version 7.1.7.2606) was used to estimate the length of the shoreline. This total shoreline distance was divided into 500-m sections and designated unique values. Sites were selected randomly and assigned a gear type using a random number generator applied to the unique values. These same sites have been sampled 2016-2019 and will continue to be sampled in successive years.

Angler Catch Rates

Six fixed dates were randomly selected, three weekdays and three weekend days, for spring and fall index creel surveys. Fixed dates are defined as the same day of each year (e.g. the first Tuesday of May). The spring survey was conducted between April 28 and June 12 and the fall survey between September 7 and October 12, 2019. Selected dates were subdivided into two five-hour time slots, 0900 to 1400 h and 1500 to 2000 h. One of these time slots was randomly selected for each date as the time of the creel survey. The two most popular boat ramps located at C.J. Strike Reservoir are Air Force and Cottonwood boat ramps and were selected as suitable locations to collect creel data. This survey design was based on a portion of access-access survey described by Pollock et al. (1994).

Only completed fishing trip information was used for catch rate estimation to avoid bias associated with incomplete trips (MacKenzie 1991; Hoenig et al. 1997). Individual interview queries included party size, primary target species, harvest by species, release by species and angler residency. Interview data was summarized as the ratio of means by calculating the catch-per-unit-effort (CPUE) for each angler and then averaging those values based on targeted species categories. Catch rates, variance and confidence intervals were derived using the multiday estimator found in McCormick and Meyer (2017).

Spring Relative Abundance

Fish populations in C.J. Strike Reservoir were sampled with standard IDFG lowland lake sampling gear (Butts et al. 2011) from May 9 to May 23, 2019. Gear included paired sinking/floating gillnets, trap nets and night boat electrofishing. Paired gillnet sets consisted of one floating and one sinking monofilament nets (46m x 2m with six panels composed of 19-, 25-, 32-, 38-, 51- and 64-mm bar mesh sizes), nets were set approximately 100 m apart. Paired nets were fished for one night, equaling one unit of gillnet effort. Trap nets were comprised of 19 mm bar mesh treated with black tar, 15-m leads with 1-m x 2-m frames and crowfoot throats on the first and third of five loops. One trap net fished for one night equaled one unit of trap net effort. Boat electrofishing utilized a Midwest Lake Electrofishing System (MLES) Infinity set-up set at 20% duty cycle and approximately 2,200 to 2,800 watts of pulsed DC power generated by a 6,500-

watt Honda generator. One hour of active (on-time) electrofishing equaled one unit of effort. One hour of electrofishing, divided into six, ten-minute runs; seven trap nets and four paired gillnet sets were deployed in each of the three section of C.J. Strike Reservoir, providing 12 units of effort in each section (Figure 28). Catch data were summarized as the CPUE for each gear type. Indices were calculated by standardizing the catch rate of each gear type to one unit of effort and then summing across the three gear types.

To estimate angler harvest and total catch for crappie and Yellow Perch, individuals captured in trap nets were tagged using 70-mm (51-mm tubing) fluorescent orange Floy FD-68BC T-bar anchor tags. Fish ≥ 200mm had tags inserted just beneath the dorsal fin. Tag reporting data was collected using the IDFG Tag! You're It phone system and website. Angler harvest and total catch rates of crappie and Yellow Perch were calculated from reported tags (Meyer et al. 2010; Koenig 2012). Tag reports were adjusted using a non-reward tag reporting rate of 59.7% and 58.5% and a 1-year tag loss rate of 2.8% and 1.2% for crappie and Yellow Perch, respectively (Unpublished IDFG data). Tag reporting data was analyzed for a 365-day duration after release for fish tagged in 2018.

Captured fish were identified to species, measured for total length (± 1 mm) and weighed (± 1 g for fish under 5,000 g or ± 10 g for fish greater than 5,000 g) using a digital scale. If weight was not collected, weights were estimated from the length-weight relationship derived from the catch of that species. Estimated weights were then included in biomass estimates. Relative weight (W_r) was calculated as an index of general fish body condition. A value of 100 was considered average condition, values greater than 100 were considered above average and values less than 100 were considered below average body condition. Proportional size distribution (PSD) was calculated for crappie and Yellow Perch to describe trends in length frequencies over time (Anderson and Neuman 1996). Stock size of 130 mm and quality size of 200 mm were used for both crappie and Yellow Perch (Gablehouse 1984).

Larval Fish Production and Zooplankton

Horizontal surface trawls were used to sample larval fish at 10 sites throughout C.J. Strike Reservoir (Figure 29) using a 1-m high x 2-m wide x 4-m long Neuston net with 1.3-mm mesh. Sampling took place on June 10, 17, 24, 30 and July 8 and 9, 2019; these dates overlapped with peaks of crappie production in past years. Trawling commenced at dusk and all sites were completed within four hours. Each trawl was five minutes in duration and a flow meter was fitted to the set to estimate the volume of water sampled. Specimens were fixed in 10% formalin for two weeks then rinsed and stored in 70% ethanol. A dissecting microscope was used to aid in identification to species and measuring the total length of the individual fish. If the total catch of a trawl exceeded 50 individuals, a subsample of 50 was randomly selected to be identified and measured, these values were then used to extrapolate based on the remaining sample volume. The week that had the highest crappie density averaged across all sample sites was assumed to be the larval density for the year and reported as fish per 100 m^3. Data were compared across years to categorize trends in crappie production.

Zooplankton quality index (ZQI) was initiated in the spring of 2017 and continued in 2019 following the protocol set forth in Teuscher 1999. ZQI was defined as the samples of the 500 mm and 750 mm net samples added together for a total of usable zooplankton available. Sampling was conducted at three sites within the reservoir once a month beginning in May and ending in October, which is assumed to be when age-0 panfish would be utilizing zooplankton the most. Samples were processed to determine the Zooplankton Ratio (ZPR) defined as the ratio of preferred zooplankton captured in the 750 µm net to the usable zooplankton captured in the 500 µm net.

Fall Relative Abundance

Crappie and Yellow Perch populations in C.J. Strike Reservoir were sampled again in the fall with standard IDFG lowland lake sampling gears from October 15 to 16 and October 31 to November 1, 2019. Sampling gears included those referenced in the spring survey above and consisted of the same units of effort (e.g. one floating and one sinking gillnet, fished for one night, equaled one unit of effort). Similar to the spring survey, we used equal amounts of effort in each of the sections but effort was halved from the spring sampling event with 0.5 hours of night boat electrofishing, divided into three ten minute runs, four trap nets and two paired gillnet sets were deployed in each of the reservoir sections for 6.5 units of effort (Figure 30). Sample location selection, fish and data processing methods were similar to the spring relative abundance survey described above. The same criteria was used to deploy tags in crappie and Yellow Perch captured in trap nets during the fall survey to estimate harvest and total catch.

Otter Trawl Relative Abundance

An otter trawl was used to develop an index of relative abundance for panfish species and to monitor survival from spring larval production to the onset of winter. In 2017, 12 sites were selected (four in each reservoir section) within areas with relatively uniform bottom based on depth profiles (Figure 31). Sampling of these 12 sites took place on November 4 and 5, 2019. The otter trawl net dimensions were 2.159-m x 4.572-m and 9-m long, made of 39-mm stretch mesh in the body and 13 mm mesh in the cod end. The trawl was outfitted with weighted otter doors to ensure the net remained open while in tow (Hayes et al. 1996). The net had a 15 m bridle attached to a rope and towed at a speed of 4.0 km/h with a 6.4-m boat equipped with a 175 hp outboard motor. A flow meter was placed at the connection point with the bridle and tow rope to estimate the volume of water sampled. The net was towed at each location for three minutes and GPS coordinates were recorded at the start and end of each transect.

Captured fish were identified to species, measured for total length ($\pm$ 1 mm) and weighed ($\pm$ 1 g) with a digital scale, fish less than 100 mm were not weighed due to the inaccuracy of the scale at small values. In years with high abundance, a subsample of fish was measured and weighed but abundances did not necessitate this in 2019. Densities by species were calculated as the number of fish per 100 m^3 for each trawl. Due to possible inaccuracies of the flow meter in two of the tows, the volume of water sampled was assigned the mean value from the remaining 10 tows. The mean fish density across all sample locations was calculated to index relative abundance.

Age and Growth

Dorsal fin rays were collected from up to 5 fish per species per 10-mm length interval during spring and fall relative abundance index, spring and fall creel and otter trawl surveys. Structures were processed and digitized using methods described in Butts et al. (2016). Two independent readers estimated fish age, discrepancies were revisited and the agreed upon age was used in further analysis. Age-length keys were generated separately for fish sampled in spring and fall surveys and used to allocate CPUE from each survey to the proper age-class by species. This data was also used to develop mean length-at-age by season (spring and fall) for crappie and Yellow Perch.

RESULTS

Angler Catch Rates and Harvest

Southwest regional fisheries staff interviewed 327 anglers in 134 parties (2.44 angler/party mean size) on C.J. Strike Reservoir during spring index creel surveys in 2019. Idaho residents comprised 97.25% of anglers interviewed. Anglers mainly targeted crappie in the spring followed by bass (Table 11). Spring anglers expended a total of 1,603.25 hours for a mean of 4.9 hours per angler. Total catch for the spring survey was 4,136 of which 1,385 (33.49%) were harvested. The majority of harvested fish were crappie at 92.56% of the total harvest. The next most commonly harvested fish were Smallmouth Bass which made up 3.47% of the total harvest but the majority of this species caught were released. Total catch of Yellow Perch, Bluegill, Largemouth Bass and hatchery Rainbow Trout and catfish species was minor (Table 12). The mean total length of angler-harvested crappie, Yellow Perch and Smallmouth Bass collected during the spring index creel was 224.37, 251.05 and 353.27 mm, respectively. The most frequent length bin of harvested crappie was the 210-219 mm in the spring index creel. The most frequent length bin of harvested Yellow Perch was 260-269 mm (Figure 32).

During the fall index creel survey in 2019, 103 anglers from 43 parties with a mean party size of 2.4 anglers were interviewed. Similar to the spring survey, most anglers (97.09%) were Idaho residents. Species targeted were nearly equal between crappie (*n* = 25), Yellow Perch (*n* = 27), bass species (*n* = 23) and any fish (*n* = 21) categories (Table 11). Anglers fished a total of 482.5 hours with a mean of 4.68 hours per angler. Total catch was 1,500 fish of which 477 (31.8%) were harvested. The most harvested species was crappie at 59.54% of the total harvest, followed by Yellow Perch (32.08%) and Smallmouth Bass (6.08%). As in the spring, Smallmouth Bass were released more often than harvested. Total catch of Bluegill, hatchery Rainbow Trout, Largemouth Bass and catfish species was minor in the fall survey (Table 12). Mean length of fall harvested crappie decreased from the spring survey to 221.23 mm. Yellow Perch average total length also decreased to 246.33 mm. Smallmouth Bass total length increased, on average, from the spring survey to 368 mm. The most frequent length bin of harvested crappie was the same as the spring survey, 210-219 mm. Yellow Perch's most frequently harvested length bin decreased from the spring survey to 240-249 mm (Figure 33).

Overall, angler catch rates of crappie and Smallmouth Bass were higher in the fall than in the spring surveys. Crappie average catch rate for anglers targeting crappie in the spring was 2.81 fish per hour and 3.3 fish per hour in the fall. Smallmouth Bass average catch rates for angler targeting Smallmouth Bass in the spring was 1.48 fish per hour and 2.48 fish per hour in the fall. Fish per hour could not be calculated for Yellow Perch since the seven anglers identifying themselves as targeting Yellow Perch did not catch any, although 53 Yellow Perch were caught and/or harvested as bycatch by other anglers.

Fewer anglers harvested zero to five crappie in the spring creel survey than in the fall creel survey at 78.3% and 80.6%, respectively. Spring anglers were also more likely to harvest more than 15 crappie with 10.4% of interviewed anglers doing so in the spring and 4.9% in the fall. Conversely, more anglers harvested zero to five Yellow Perch in the spring than the fall at 99.7% and 88.3%, respectively. Anglers were slightly more likely to harvest more than 15 Yellow Perch in the fall at 0.97% of interviewed anglers doing so, no interviewed anglers did so in the spring (Table 13). Yellow Perch tag return data from 2018 shows minimal returns. Conversely, crappie tag returns were moderate for the same time period, illustrating the additional effort placed on crappie by anglers (Table 14).

Spring Relative Abundance Index

Crappie were captured using all three gear types during the spring abundance survey and contributed 1,752 individuals to the total catch. Total CPUE, for crappie using all gear types was 48.67 fish per effort (f/e). CPUE was highest for crappie using electrofishing at 103.67 f/e, followed by trap nets at 47.67 f/e and gillnets at 36.67 f/e. Catch was highest for crappie in the Bruneau Arm where CPUE was 53.92 f/e, followed by the Snake Arm at 48.25 f/e and Main Pool at 43.83 f/e. Mean total length of spring sampled crappie was 198.49 mm. Mean W_r was 108.87 for spring-captured crappie and ranged from 79.75 to 173.56. This indicated that most fish were in good body condition coming out of the winter months. Mean total length of crappie in the spring was 198.5 mm. PSD for spring-captured crappie was 52 indicating balanced size structure for the population (Table 16). Length frequency for crappie was slightly left skewed in the spring survey with the most frequently captured length bin at 200-209 mm (Figure 34).

Yellow Perch were captured using all three gear types and contributed 727 individuals to the total catch during the spring abundance survey. Total CPUE, using three gear types was 20.19 f/e. Yellow Perch per effort was highest for gillnets at 51.75 f/e, followed by trap nets at 4.71 f/e and electrofishing at 2.33 f/e. CPUE for Yellow Perch was highest in the Main Pool at 31.58 f/e, followed by the Snake Arm at 16.58 f/e and Bruneau Arm at 12.42 f/e. Mean total length of spring sampled Yellow Perch was 219.10 mm. Mean W_r was 84.93 for spring-captured Yellow Perch greater than 100 mm and ranged from 55.80 to 128.85. This indicated that most fish were in moderate body condition coming out of the winter months. Mean total length of spring sampled Yellow Perch was 219.1 mm. PSD for spring-captured Yellow Perch was 65 indicating a size structure slightly skewed toward larger individuals (Table 16). Length frequency for Yellow Perch was even across length bins with the most frequently captured bin at 190-199 mm (Figure 35).

Larval Fish Production and Zooplankton

Larval production on C.J. Strike was slightly above average based on 10 Neuston net tows completed in 2019. The average water volume sampled during larval fish tows in 2019 was 183.3 m^3/tow. Species composition for samples collected included crappies (98.1%) and Yellow Perch (1.9%). The peak density of larval crappie (89.91 fish/100m^3) was observed on the second sampling event on June 17. Within C.J. Strike Reservoir, peak densities of larval crappie recorded since 2005 have averaged 24 fish/100m^3. When averaged across all sampling sites, density of larval crappie in 2019 was 53.53 fish/100m^3 (Figure 36).

Highest densities of zooplankton sampled on C.J. Strike Reservoir were collected in June 2019 with 9.27 g/tow. The Bruneau Arm consistently had the lowest zooplankton values, followed by the Snake Arm and Main Pool. Zooplankton sampling took place in August, September and October but that data was not available at the time of this report (Figure 37).

Fall Relative Abundance Index

A total of 198 crappie were sampled during fall relative index surveys on C. J. Strike Reservoir in 2019. Total crappie CPUE using three gear types was 10.15 f/e. Electrofishing resulted in the highest crappie CPUE at 26.67 f/e, followed by gillnets (12.17 f/e) and trap nets (7.08 f/e). Crappie CPUE was highest in the Snake River Arm at 14.46 f/e followed by the Bruneau Arm at 8.62 f/e and the Main Pool at 7.38 f/e. Relative weights for crappie captured averaged 94.69 and ranged from 72.88 to 133.89; indicating that most crappie had moderate body condition prior to entering the winter. Mean total length of fall sampled crappie was 222.79 mm. PSD for fall-captured crappie was 84, showing a skewed size structure with more large individuals present (Table 16). The most frequently captured length bin was 230-239 mm, increasing from the spring survey (Figure 34).

A total of 245 Yellow Perch were sample during fall relative index surveys on C. J. Strike Reservoir in 2019. Total Yellow Perch CPUE using the three gear types was 12.56 f/e. Gillnets resulted in the highest Yellow Perch CPUE with 29.5 f/e, followed by trap nets (5.42 f/e) and electrofishing (2 f/e). CPUE was highest for Yellow Perch in the Snake Arm at 18.46 f/e, followed by the Main Pool (14.00 f/e) and Bruneau Arm (5.38 f/e). Relative weights for Yellow Perch averaged 89.57 and ranged from 60.16 to 144.13, meaning that most Yellow Perch had fair to good body condition prior to entering the winter. Mean total length of Yellow Perch was 241.74 mm. Yellow Perch PSD value was 96, indicating a heavily skewed size structure toward large individuals (Table 16). The most frequently captured length bin for Yellow Perch also increased from the spring survey to 240-249 mm (Figure 35).

Otter Trawl Relative Abundance

The average water volume sampled during 2019 otter trawl sampling was 1695.82 m^3 per tow. A total of 330 fish were captured with species composition consisting of crappie (39.70%), Yellow Perch (39.09%) and Bluegill (18.18%); Smallmouth Bass, Common Carp, Largescale Sucker and Peamouth all contributed less than 2% each. Bluegill and crappie were captured at more sites (n = 9) than any other species, followed by Yellow Perch (n = 8). Densities of panfish species were highest in the Main Pool (2.21 fish/100 m^3) followed by the Bruneau (2.02 fish/100 m^3) and Snake Arms (1.45 fish/100 m^3). Crappie density averaged 0.54 fish/100 m^3 and ranged from 0 fish/100m^3 to 3.76 fish/100 m^3. Yellow Perch density averaged 0.79 fish/100 m^3 and ranged from 0 fish/100m^3 to 3.47 fish/100 m^3. Bluegill density averaged 0.39 fish/100 m^3 and ranged from 0 fish/100 m^3 to 2.08 fish/100 m^3. Densities were more consistent within the Bruneau Arm with more site-specific capture in the Main Pool and Snake Arm (Figure 38). Length frequencies for crappie and Yellow Perch captured by otter trawl in 2019 depict two distinct cohorts of these species, suggesting that more larval fish had survived into the fall (Figure 34 - 35).

Age and Growth

Age and growth data in 2019 were very similar to that observed in the previous three years. To develop length-at-age metrics and proportion of CPUE by year class, 142 fish (spring n = 82, fall n = 60) were aged using dorsal fin rays. Mean length-at-age differed slightly between spring and fall surveys for both crappie and Yellow Perch (Figure 39). This difference is most notable in the age-3 and age-4 categories due to a smaller sample size for these ages. The most numerous age class sampled for crappie was age-2 for both seasons.

DISCUSSION

The panfish assessment began in 2016 in an attempt to better understand population dynamics of crappie and Yellow Perch in C.J. Strike Reservoir. Following a strong year class of crappie produced in 2017, this project has continued to track the 2017 cohort through time to identify possible survival bottlenecks and assess their impact on subsequent year classes. This assessment continued in 2019, collecting valuable information on crappie since little is known about this species in western reservoirs.

Creel survey data indicates that individual angler effort and demographics have remained similar since 2016. In 2016 and 2017, the number of interviews conducted during each season were nearly equal (Peterson et al. 2018; Cassinelli et al. 2018). However, beginning in 2018 and continuing in 2019, most of the angler interviews have been conducted in the spring index creel, likely due to the crappie fishing being more active in the spring. Angler harvest of crappie in the spring increased from 51% of total harvest in 2018 to 92.56% of the 2019 total harvest, reflecting the success anglers are having catching the mature 2017 cohort. Yellow Perch harvest also increased in the fall of 2019 to 59.54% of total harvest compared to 3% in 2018. Another noted change between 2019 and the previous year is that the age of harvested crappie; previously, anglers harvested mostly age-1 crappie. Age-2 crappie made up the majority of both the angler creel and the relative abundance surveys.

Harvest of crappie increased from 229 individuals in the spring of 2018 to 1,282 individuals in the spring of 2019, corresponding to an increase in angler CPUE from 0.17 fish per hour to 1.35 fish per hour. The highest CPUE rates for crappie were observed in the fall surveys, likely due to fewer anglers targeting crappie but still experiencing high crappie catch rates in the fall. The majority of crappie harvested in 2019 were age-2, corresponding to the large year class of 2017 becoming mature, harvestable fish.

From 2016 and 2018, most harvested crappie were greater than 230 mm in total length. If total harvest of crappie were to become an issue at C.J. Strike Reservoir, this length was suggested as a minimum length limit that could be implemented which would have reduced harvest by 61% in 2019. Before implementing such a rule, a comprehensive understanding of harvest, age, growth and mortality data are needed. Additional years of the index creel survey will help us refine the patterns in angler catch and how these are related to population metrics generated by various sampling gears. These surveys should be continued for one to two more years. This would span the life cycle of both strong and weak year classes currently present in the population and provide for a more detailed analysis of whether harvest restrictions would benefit the fishery.

Differences in frequency of bag were observed between the two previous years and 2019. Similar to past years, the majority of the anglers harvested less than five crappie or Yellow Perch combined. As additional crappie from the 2017 year class grow and recruit to the fishery, it was assumed that observations of larger bag of crappie would likely become more frequent. In the 2019 creel surveys the vast majority of anglers were still harvesting less than five crappie. Anglers harvesting more than 15 crappie at a time were mostly observed in the spring survey, interestingly contrary to the CPUE values for crappie which increased from 1.35 fish per hour to 3.25 fish per hour in the fall.

In 2019, we continued the current systematic sampling design using multiple gear types in both the spring and fall to develop representative indices of crappie and Yellow Perch populations in C.J. Strike Reservoir. These surveys were initiated in 2017 (Cassinelli et al. 2018) to establish an age-specific index of crappie and Yellow Perch by relative abundance. This will allow for estimates of mortality and provide a better understanding of gear-specific biases. Monitoring age-specific relative abundances should enable us to identify population bottlenecks such as overwinter mortality. In the spring and fall, electrofishing produced the highest CPUE, aligning with previous studies where electrofishing produced the highest catch rates for crappie (Butts et al. 2011; Dillon 1989). Based on Dillon (1989), catch rates using the current gear types and methods should allow us to detect changes in the panfish populations through time. The primary objective of the fall relative abundance and otter trawl surveys was to capture smaller and younger panfish than those captured by anglers or in the spring survey. In 2019, these surveys were successful at indexing age-0 and age-1 crappie and Yellow Perch. CPUE increased between the spring and fall surveys for both species, due to the increased catch of age-1 and age-2, similar to 2018 (Cassinelli et al. 2018).

Age-2 crappie dominated the sample for the spring and fall relative abundance surveys and the otter trawl survey in 2019. This year class dominance presents a unique opportunity to follow the 2017 year class of crappie through their life cycle to determine important factors such as age at maturity, growth rates, and annual mortality rates (both fishing and natural). Following the year class should also help us identify which sampling techniques work best at different life stages. Therefore, we will continue the current systematic sampling design, using multiple gear types in both the spring and fall to develop representative indices of crappie and Yellow Perch populations in C.J. Strike Reservoir.

Relative production of larval crappie in C.J. Strike Reservoir has been indexed by regional staff for the past 14 years. Spatial and temporal variation was again observed in the 2019 assessment and suggesting that sampling should continue across multiple weeks to identify peak larval production. Generally, more larvae are observed in the Bruneau Arm of the reservoir, likely a function of the warmer waters and greater availability of zooplankton relative to the other sections of the reservoir. These differences in each section's environmental factors may influence primary productivity, fish reproductive success or recruitment (Butts et al. 2011). The 2019 survey represented the fourth time larval Yellow Perch have been reported. Monitoring larval crappie and Yellow Perch production will be important to estimating survival of these species at multiple life-stages and should continue.

Length-at-age comparisons for crappie and Yellow Perch across survey years were relatively similar to one another. A more in-depth analysis of growth by year-class will be completed with additional years of data. Both species continue to exhibit growth throughout the summer as mean length-at-age increased between the spring and fall surveys, similar to 2017 (Cassinelli et al. 2018). Small sample sizes were largely responsible for ages where this result was not present. Relative weights suggest that most fish have good body condition coming out of the winter and again in the fall prior to entering winter. Dorsal fin rays continue to produce quality results that can be used to generate length-age keys to assign individual sampled fish to specific age classes. Growth appears to vary slightly between survey years but separation (based on mean length-at-age) of year classes is still fairly well defined. Based on current understanding of age and growth for these populations, collecting five fish per 10-mm length bin should be sufficient to identify age class breaks and overlaps in size structure between year classes.

RECOMMENDATIONS

1. Continue the index creel survey in both the spring and fall to identify angler use patterns, specifically related to panfish populations found in C.J. Strike Reservoir.

2. Continue sampling larval production and assess relationships between larval and older age classes using otter trawl density estimates.

3. Continue the systematic sampling protocol for C.J. Strike Reservoir using gill nets, trap nets and electrofishing to develop a representative index of crappie and Yellow Perch populations.

4. Continue collecting age structure data; using dorsal fin rays to develop length-age keys. Based on previous data, collect five fish per 10 mm length bin of both crappie and Yellow Perch.

Table 10. Species targeted by anglers in the 2019 spring and fall index creel surveys at C.J. Strike Reservoir.

Targeted species	Spring Anglers	Fall Anglers	Total
Crappie	168	25	193
Yellow Perch	7	27	34
Bass species	73	23	96
Trout	23	7	30
Catfish species	2	0	2
Any fish	52	21	73
Total	327	103	430

Table 11. Catch and CPUE (fish/hour) estimates collected from anglers during the spring index creel survey at C.J. Strike Reservoir in 2019.

	Crappie	Yellow Perch	Smallmouth Bass	Bluegill	Rainbow Trout	Largemouth Bass
Harvested	1282	30	48	12	6	0
Harvest CPUE	1.35	-	0.08	-	0.06	-
Released	1581	23	1066	51	9	5
Release CPUE	1.46	-	1.40	-	0.10	-
Total catch	2863	53	1114	63	15	5
Total catch CPUE	2.81	-	1.48	-	0.16	-

Table 12. Catch and CPUE (fish/hour) estimates collected from anglers during the fall index creel survey at C.J. Strike Reservoir in 2019.

	Crappie	Yellow Perch	Smallmouth Bass	Bluegill	Rainbow Trout	Largemouth Bass
Harvested	284	153	29	8	0	0
Harvest CPUE	3.25	1.14	0.03	0.01	-	-
Released	47	136	825	8	1	4
Release CPUE	0.05	1.06	2.4	0.02	-	-
Total catch	331	289	854	16	1	4
Total catch CPUE	3.3	2.2	2.42	0.04	-	-

Table 13. The number and (percentage) of harvested crappie and Yellow Perch collected from angler interviews at C.J. Strike Reservoir during the 2019 spring and fall creel surveys.

Angler Harvest	Spring 2019		Fall 2019	
	Crappie	**Yellow Perch**	**Crappie**	**Yellow Perch**
0	205 (62.7%)	309 (94.5%)	72 (69.9%)	82 (79.6%)
1	16 (4.9%)	11 (3.4%)	4 (3.9%)	6 (5.8%)
2	13 (4.0%)	5 (1.5%)	4 (3.9%)	3 (2.9%)
3	10 (3.1%)	1 (0.3%)	0 (0%)	0 (0%)
4	4 (1.2%)	0 (0%)	2 (1.9%)	0 (0%)
5	8 (2.4%)	0 (0%)	1 (0.97%)	1 (0.97%)
6	9 (2.8%)	1 (0.3%)	2 (1.9%)	0 (0%)
7	4 (1.2%)	0 (0%)	1 (0.97%)	2 (1.9%)
8	2 (0.6%)	0 (0%)	1 (0.97%)	0 (0%)
9	3 (0.9%)	0 (0%)	0 (0%)	0 (0%)
10	6 (1.8%)	0 (0%)	6 (5.8%)	5 (4.9%)
11	4 (1.2%)	0 (0%)	0 (0%)	0 (0%)
12	2 (0.6%)	0 (0%)	0 (0%)	2 (1.9%)
13	2 (0.6%)	0 (0%)	0 (0%)	0 (0%)
14	0 (0%)	0 (0%)	0 (0%)	1 (0.97%)
15	5 (1.5%)	0 (0%)	5 (4.9%)	0 (0%)
>15	34 (10.4%)	0 (0%)	5 (4.9%)	1 (0.97%)

Table 14. T-Bar Anchor tag return rates for Yellow Perch and Crappie tagged in C.J. Strike Reservoir in 2018, as of January 19, 2019.

Species	Month	Tags released	Tags returned	Use
Yellow Perch	April	154	5	7.40%
	May	83	4	11.00%
	October	38	3	18.10%
Crappie	April	34	9	60.50%
	May	203	13	14.60%
	October	160	16	22.90%

Table 15. The proportional size density (PSD) for crappie and Yellow Perch captured in the spring and fall surveys from 2017 to 2019.

Year	Season	PSD Crappie	PSD Yellow Perch
2017	Spring	70	71
	Fall	70	88
2018	Spring	72	66
	Fall	36	70
2019	Spring	52	65
	Fall	84	96

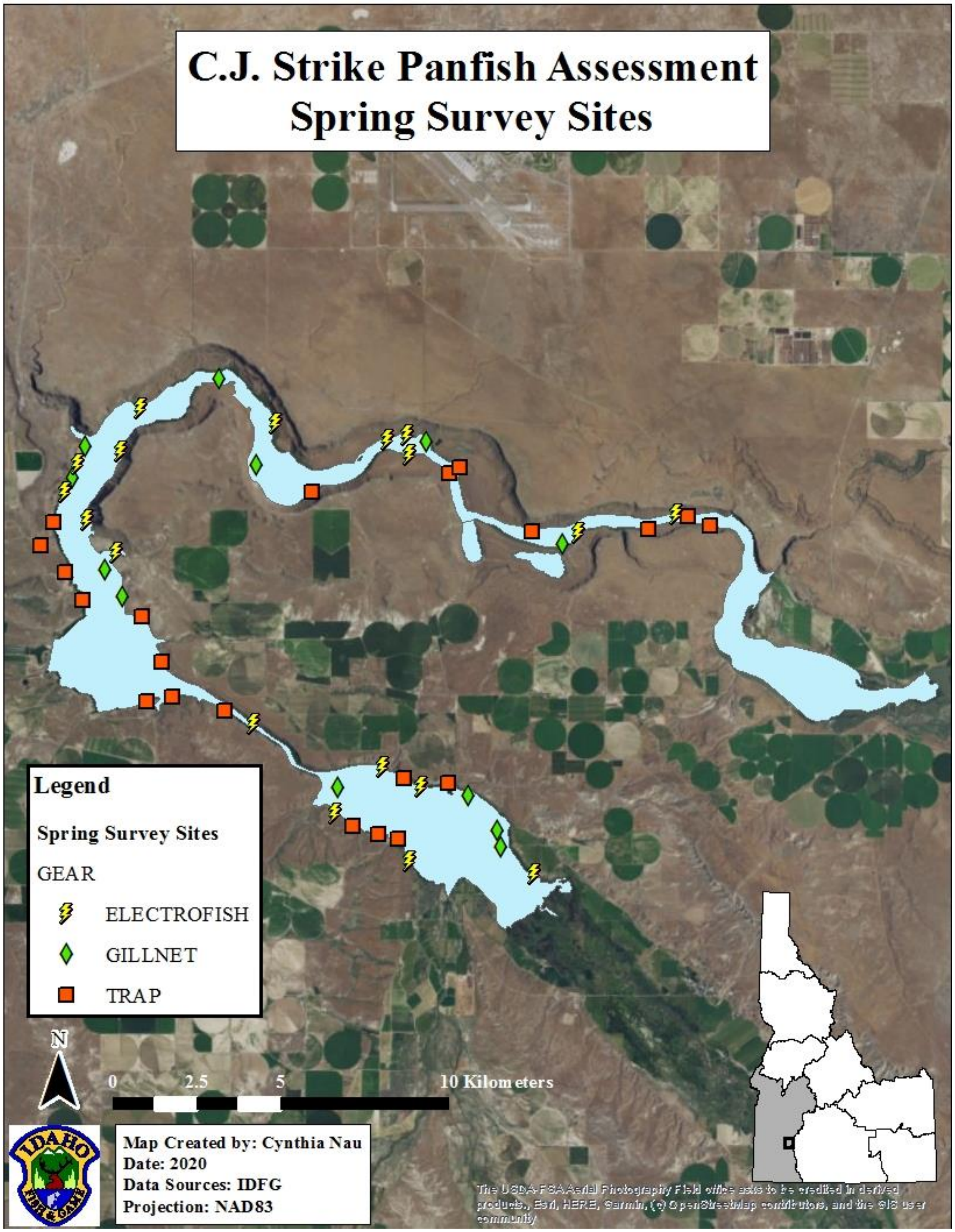


Figure 32. Location of 18 electrofishing (bolts), 21 trap net (squares), and 12 gill net (diamonds) sites used to index the relative abundance of crappies, Yellow Perch, and other game and non-game fish populations in CJ Strike Reservoir in spring 2019.

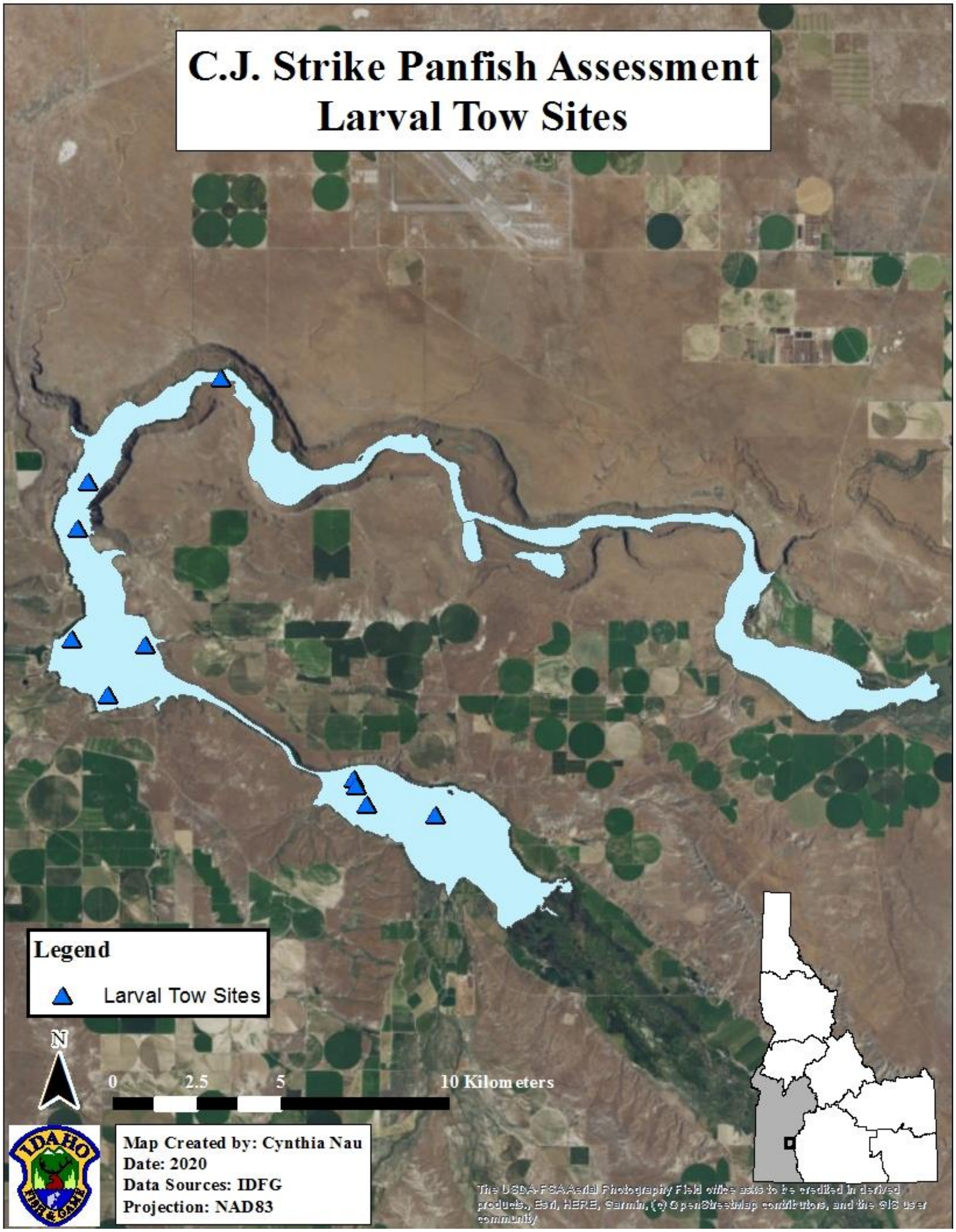


Figure 33. Location of 10 Neuston net trawl sites used to index the abundance of larval fish in CJ Strike Reservoir from 2005-2019.

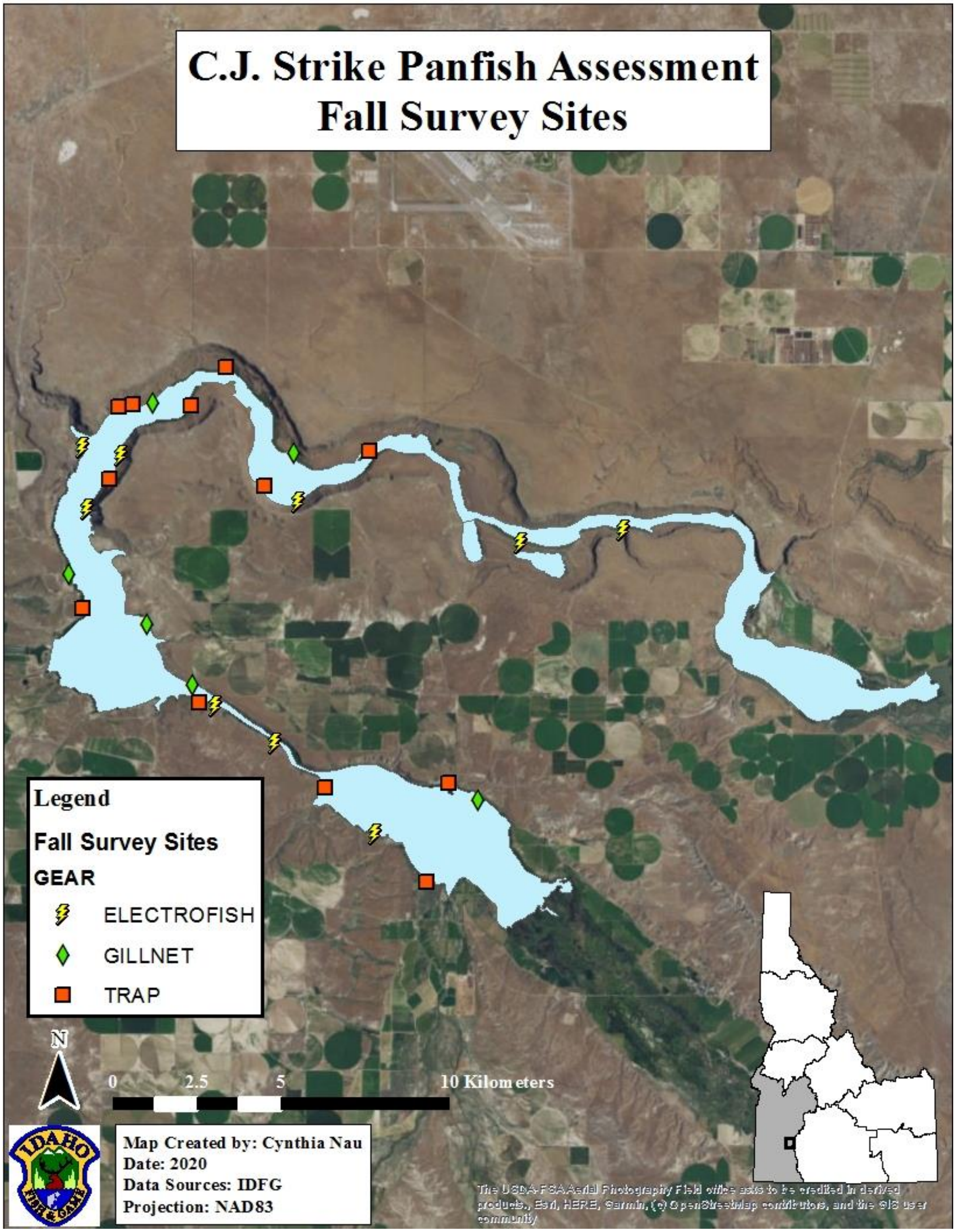


Figure 34. Location of 9 electrofishing (bolts), 12 trap net (squares), and 6 gill net (diamonds) sites used to index the relative abundance of crappies and Yellow Perch in CJ Strike Reservoir in fall 2019.

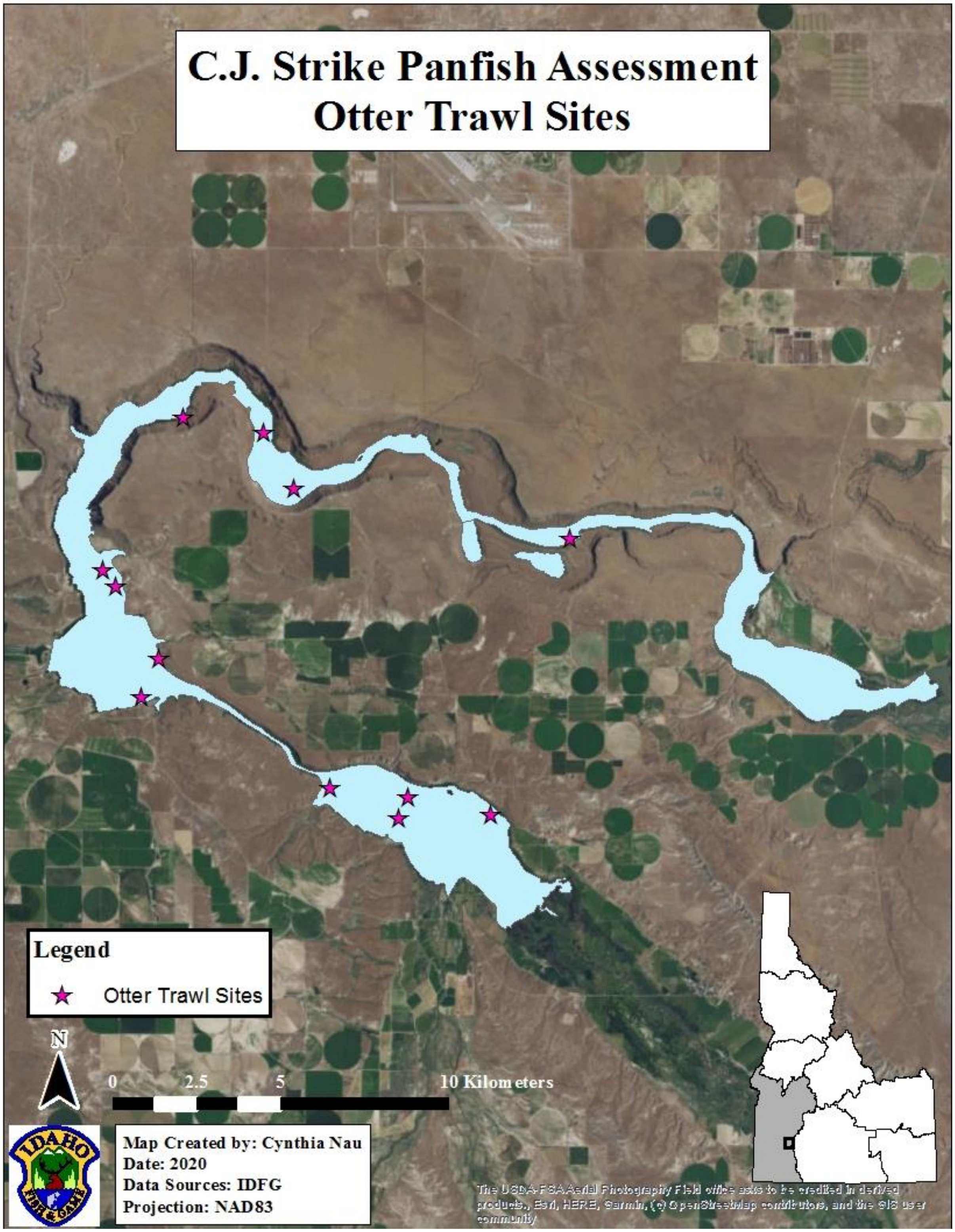


Figure 35. Location of 12 otter trawl sites used to index the abundance of crappie, Yellow Perch and Bluegill in CJ Strike Reservoir in 2019.

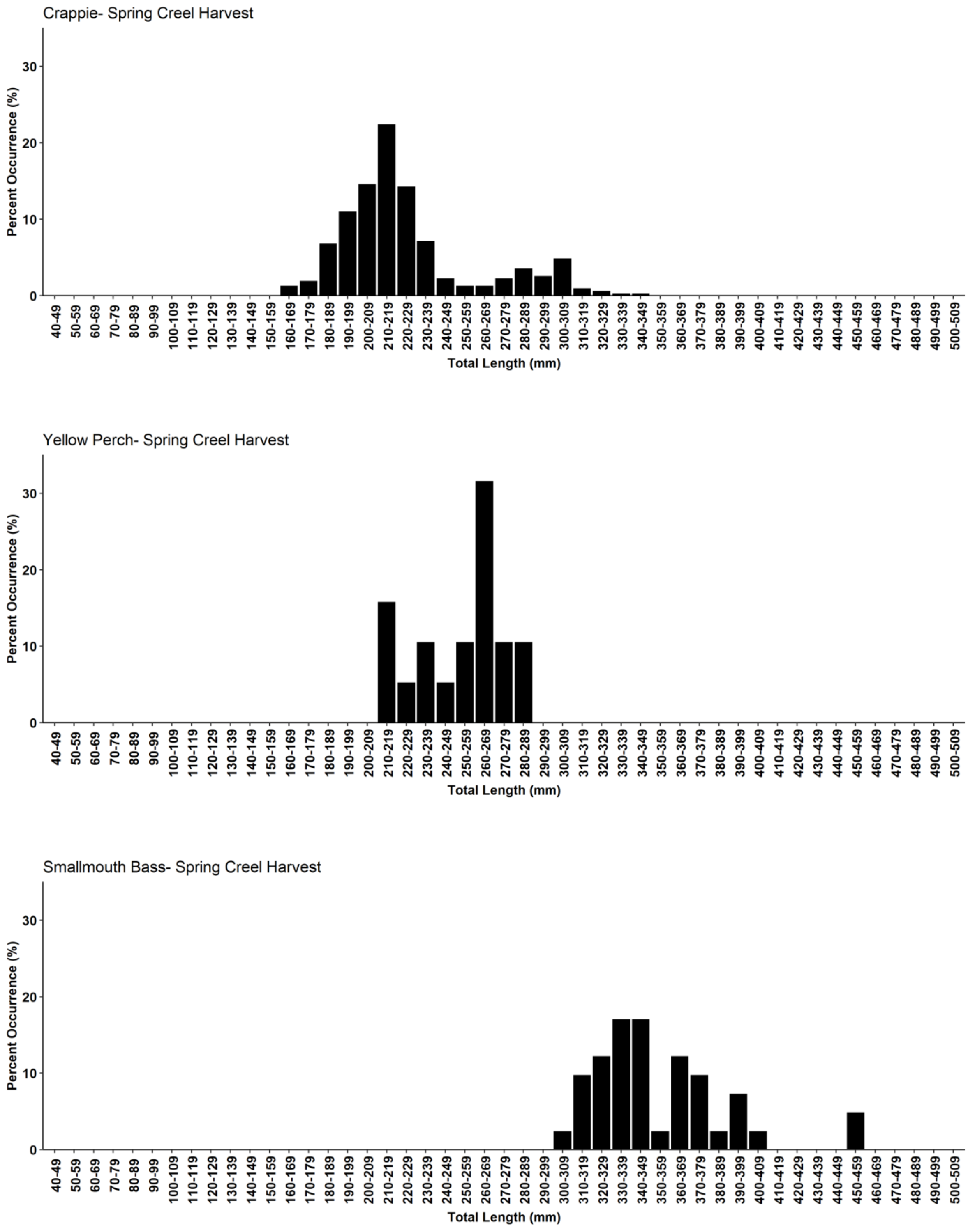


Figure 36. Length bin percentages observed for crappie, Yellow Perch, and Smallmouth Bass harvested during the spring index creel in 2019.

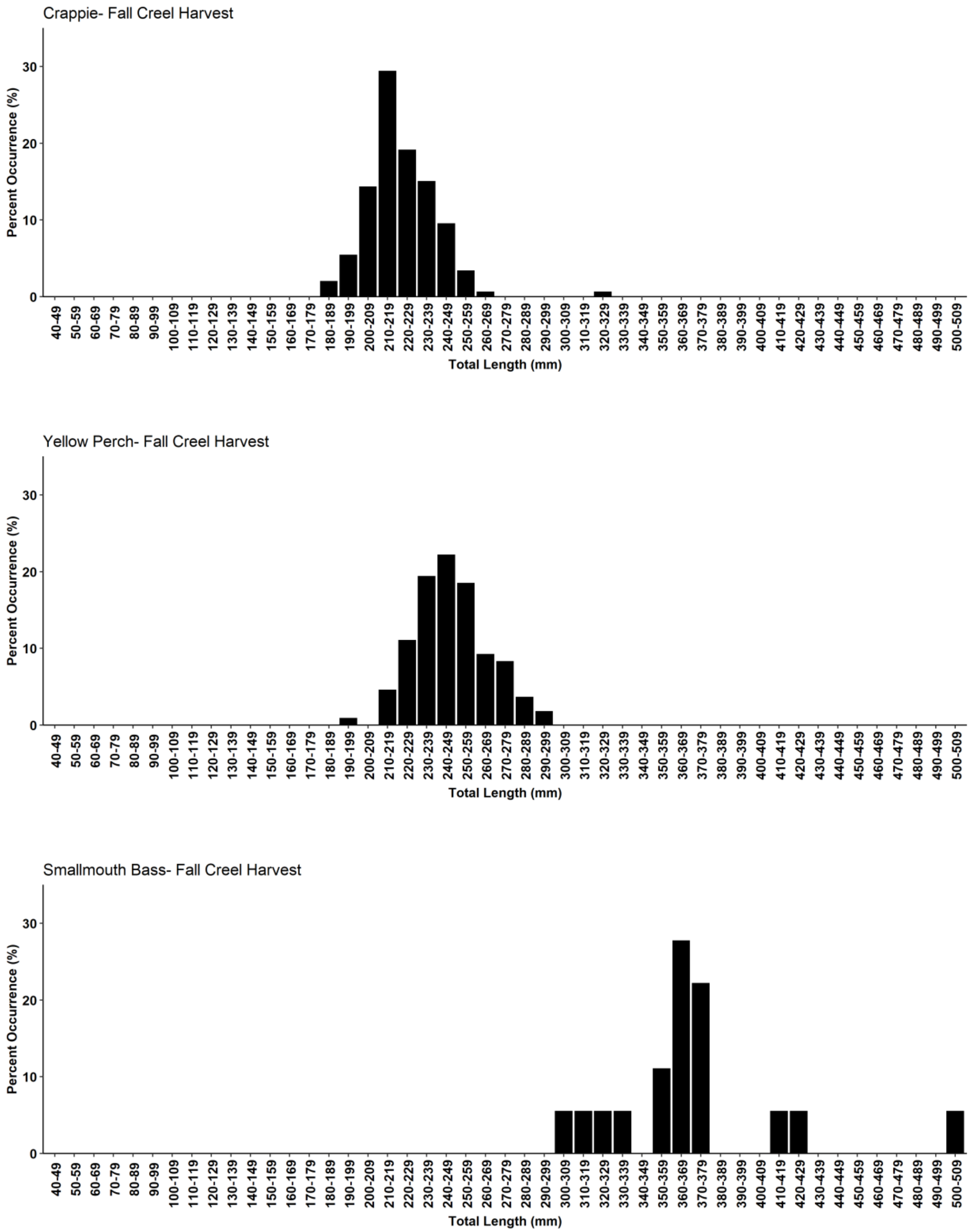
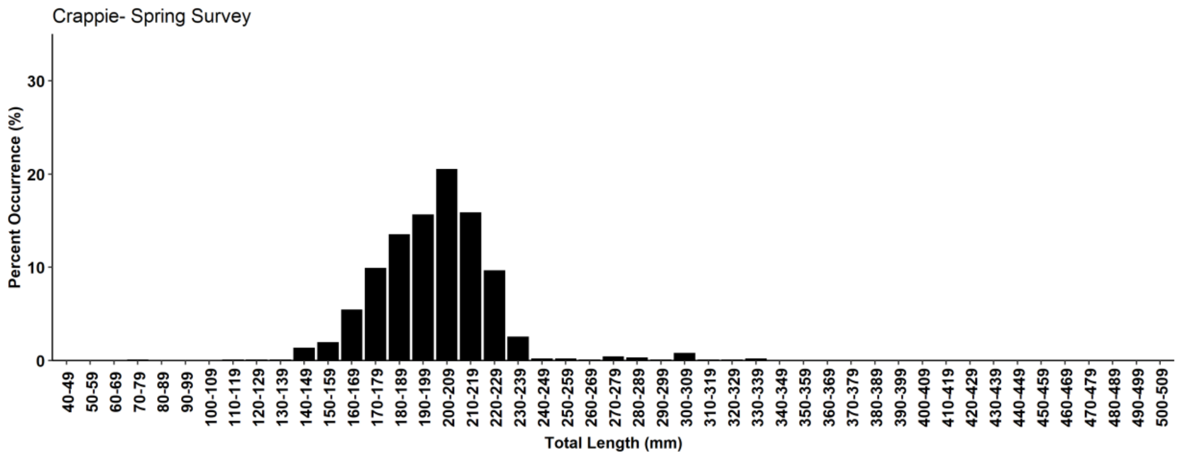
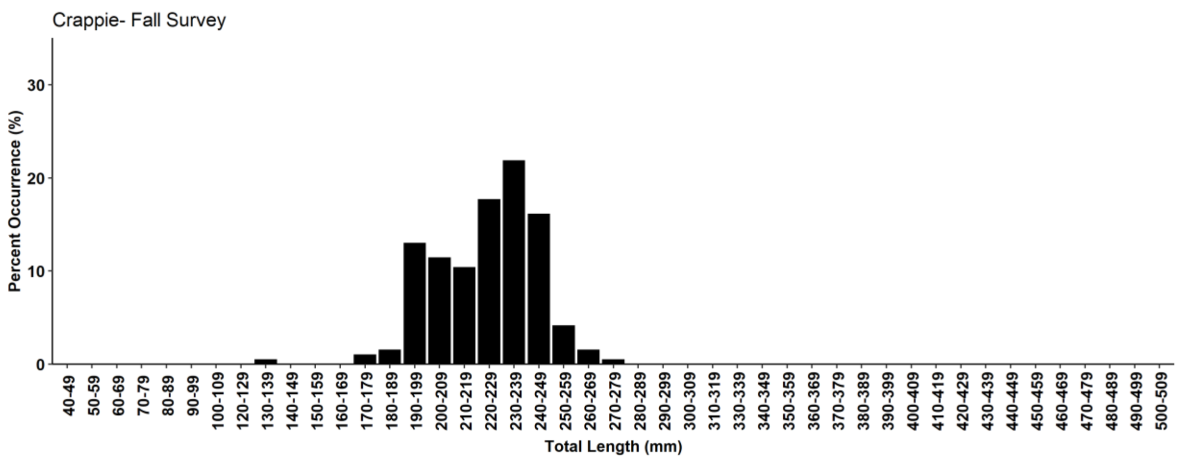


Figure 37. Length bin percentages observed for crappie, Yellow Perch and Smallmouth Bass harvested during the fall index creel in 2019.





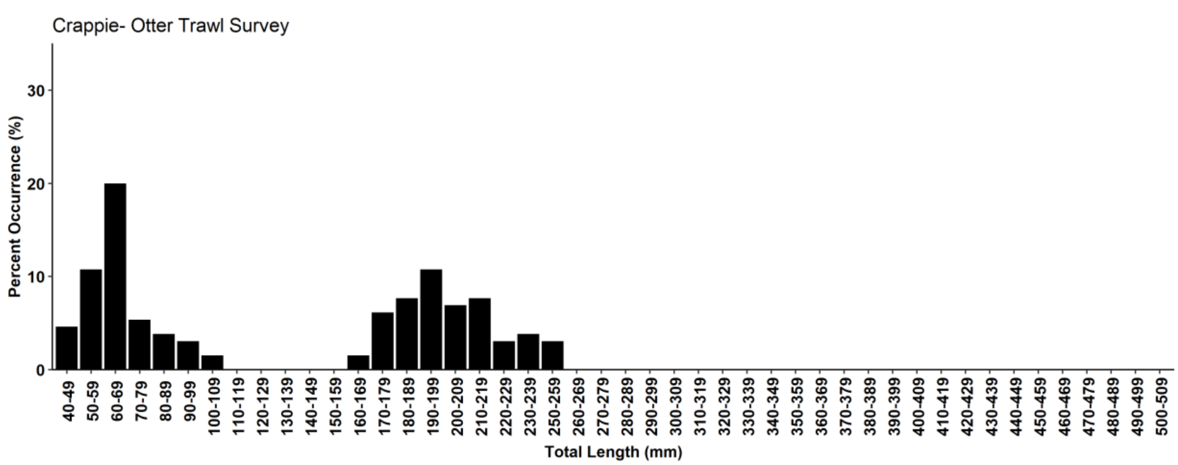


Figure 38. Length bin percentages observed for crappie during the spring, fall and otter trawl surveys of 2019.

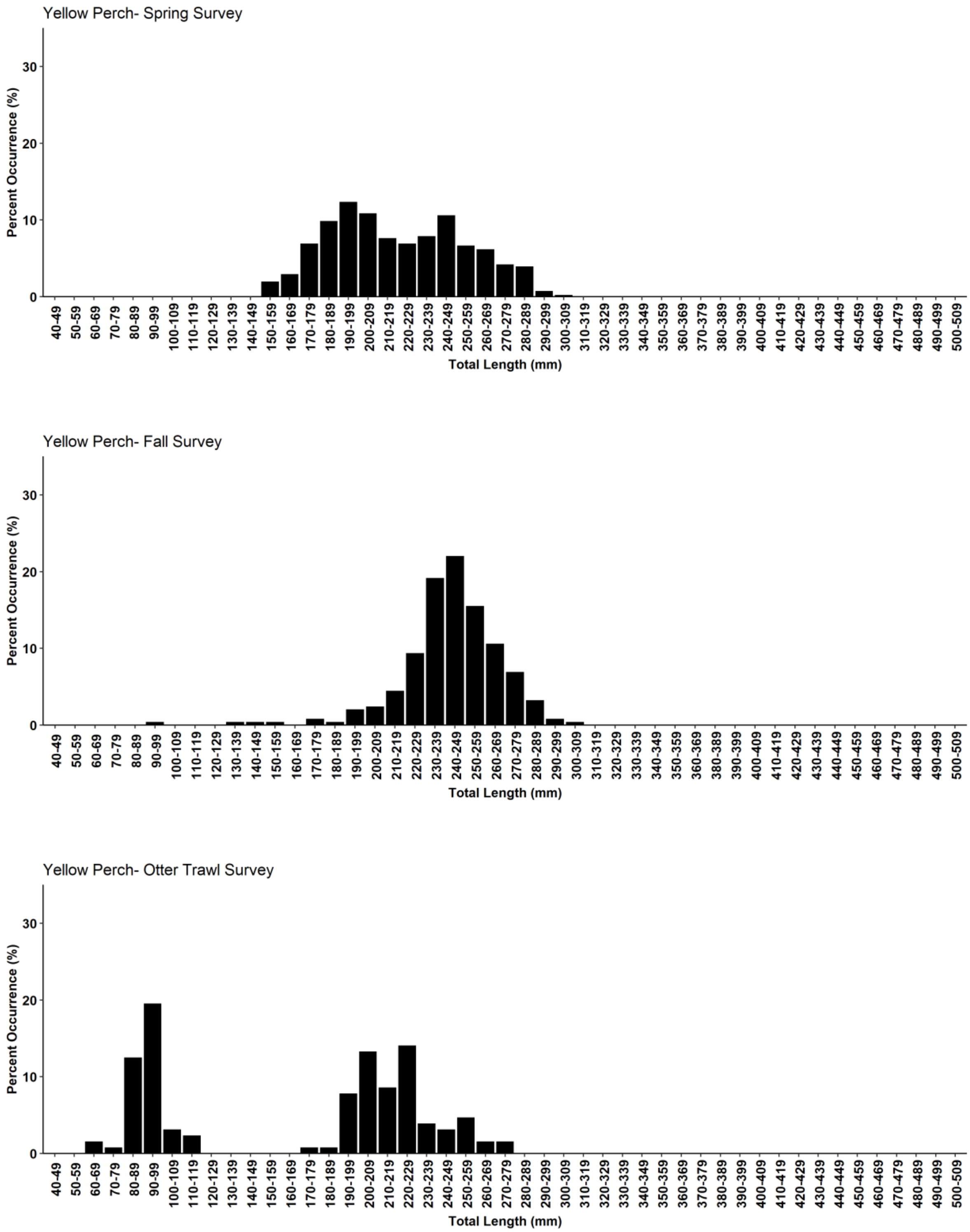


Figure 39. Length bin percentages observed for Yellow Perch during the spring, fall and otter trawl surveys of 2019.

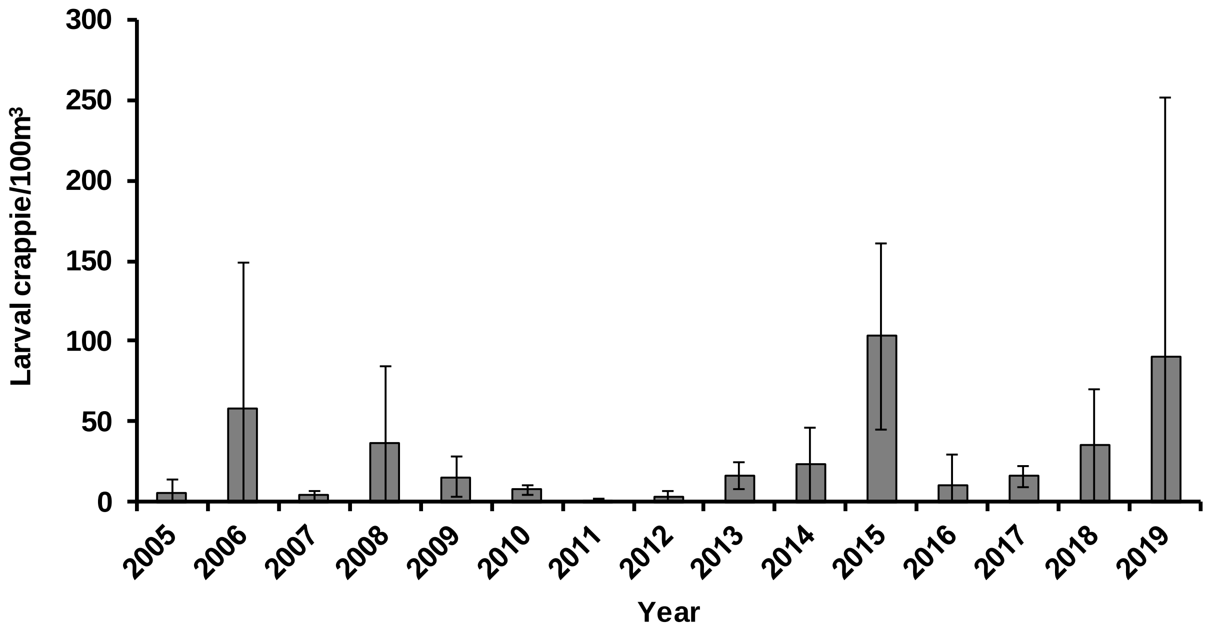


Figure 40. Peak densities of larval crappie averaged across the sample sites within C.J. Strike Reservoir from 2005 to 2019. Error bars represent 90% confidence intervals.

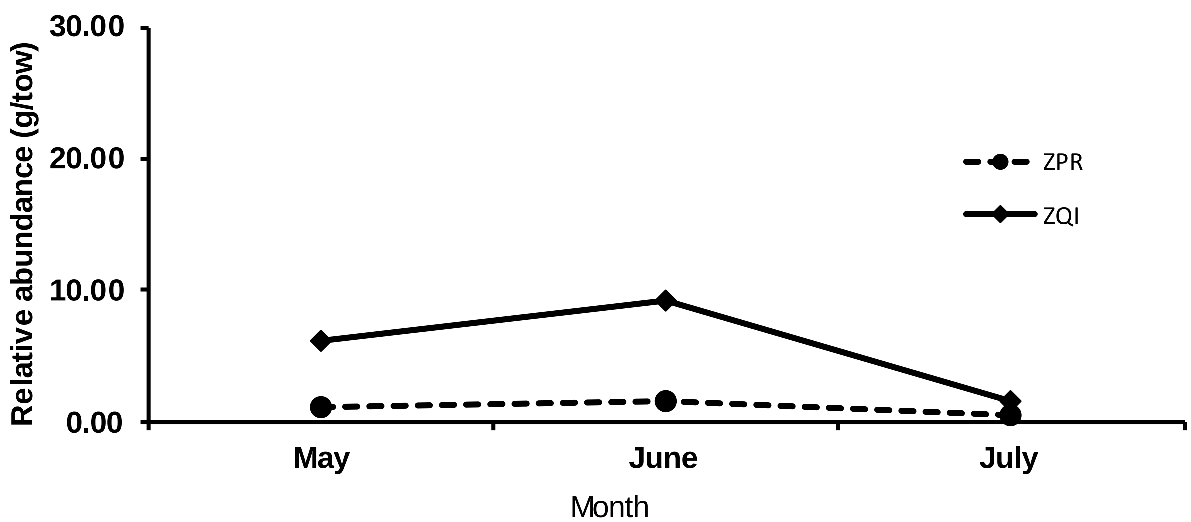


Figure 41. Zooplankton preferred ratio (ZPR) and zooplankton quality index (ZQI) average values for three sampling locations in C.J. Strike Reservoir in 2019.

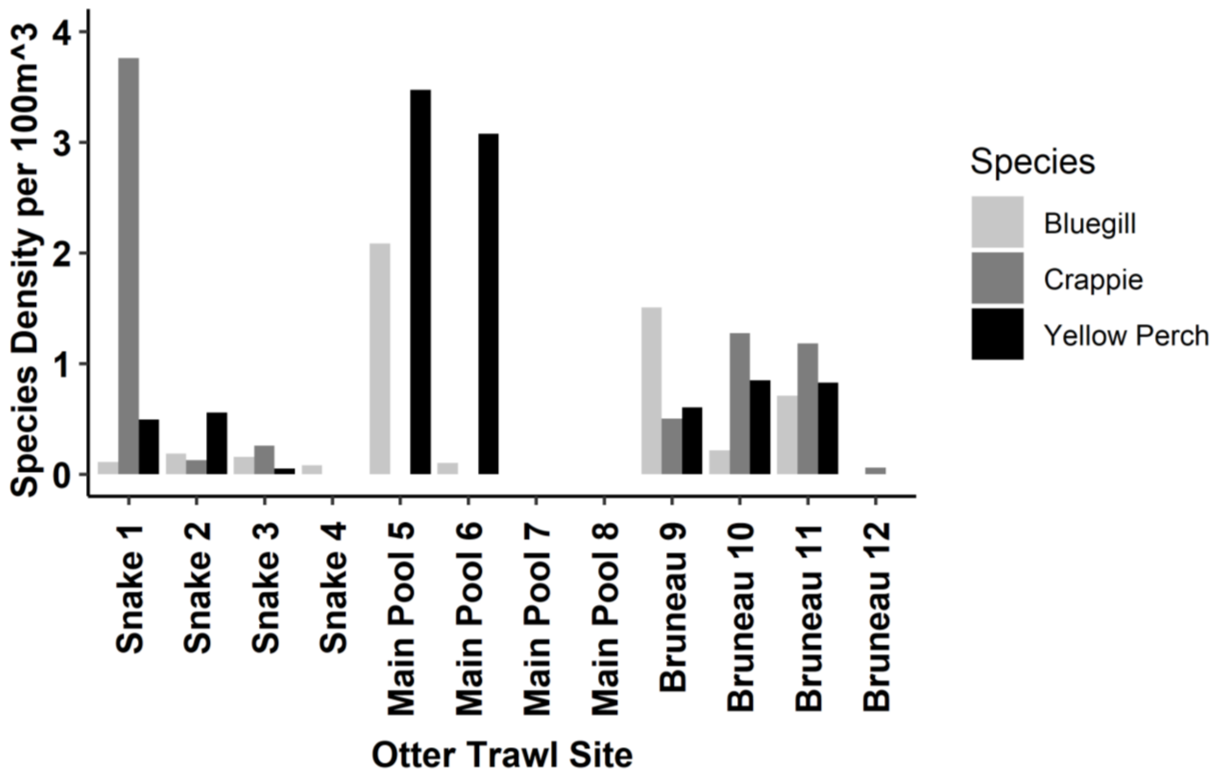


Figure 42. Species density observed for Bluegill, crappie and Yellow Perch during the otter trawl surveys of 2019.

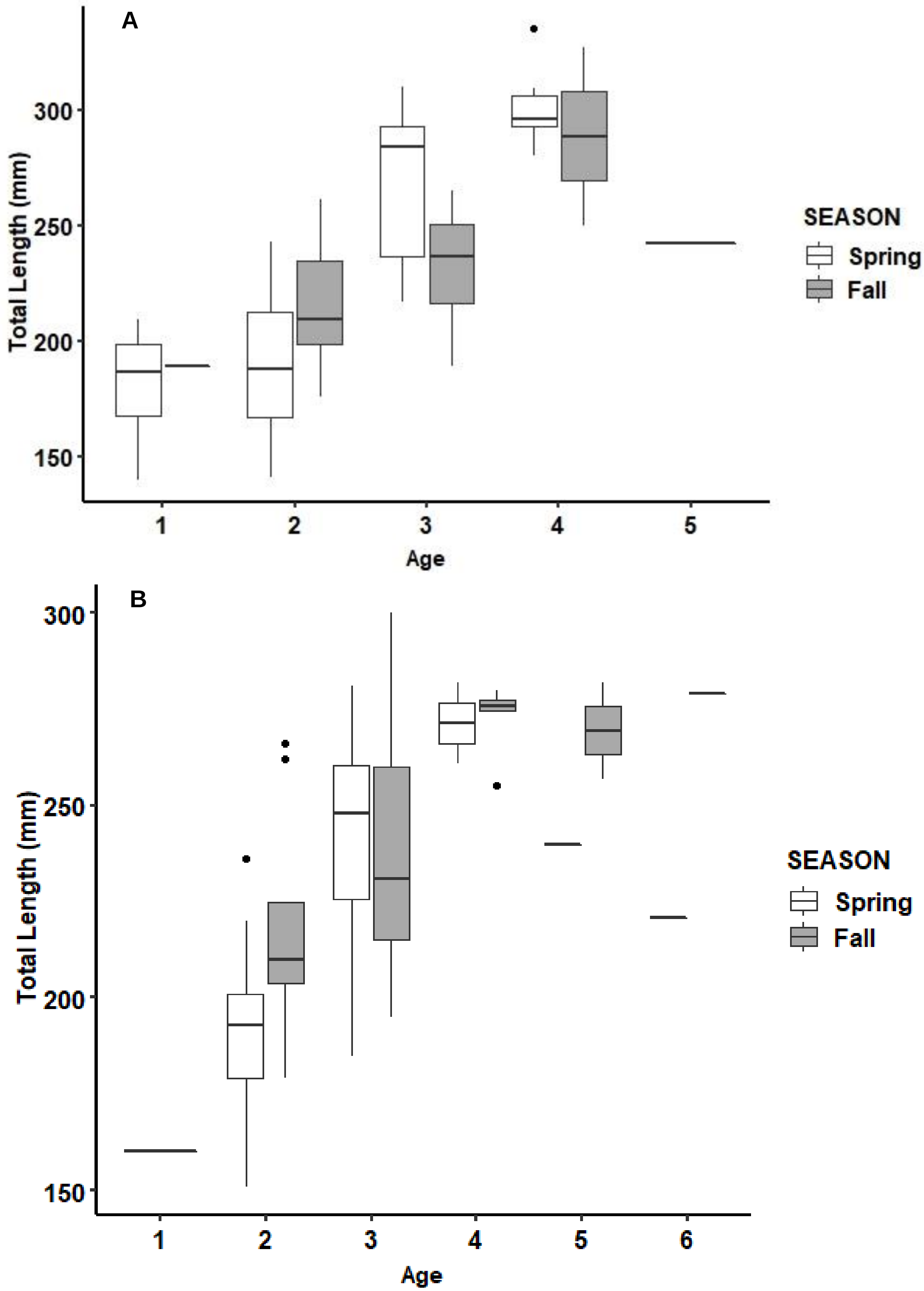


Figure 43. Length-at-age boxplots for all crappie (A) and Yellow Perch (B) aged in 2019, taken in both the creel and relative abundance surveys.

ALPINE LAKES

ABSTRACT

Idaho Department of Fish and Game (IDFG) staff from the Southwest Region surveyed three alpine lakes during August 2019. Sampling efforts focused on headwater portions of the North Fork Boise River. None of the lakes had been surveyed in the last 20 years. Data were collected at each lake that described fish and amphibian populations, habitat, as well as human use patterns.

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INTRODUCTION

IDFG Region 3 fisheries staff samples a handful of alpine lakes each summer. This sampling is part of ongoing monitoring to assess the alpine lake stocking program. Stocked lakes (and any adjacent unstocked lakes) are surveyed to better understand fish population structure and abundance and determine is current stocking rates and frequencies are adequate and justified. Lakes with the longest window since the previous survey, or those lakes that have never been surveyed, are prioritized each year. Typically, a single week of sampling is allocated to alpine lakes so a cluster of lakes in close proximity to each other are surveyed annually.

OBJECTIVES

1. Describe the distribution, relative abundance, and species composition of fish and amphibian populations at alpine lakes in the Southwest Region.

2. Adjust stocking where appropriate to use hatchery resources efficiently and minimize impacts to native fauna while preserving fishing opportunity where practical.

METHODS

Alpine lakes were surveyed August 5, 6, and 7, 2019. We sampled Jennie (Big Bear Creek) Lake on August 5, Cow Lake on August 6, and Big Buck Lake on August 7 (Figure 40). Lakes were chosen because they either had never been sampled, or had not been sampled within the last twenty years. At each lake, we assessed fish and amphibian presence/absence, human use, and basic fish habitat characteristics. Fish were sampled with hook/line angling to determine species and total length (TL, mm). Catch per unit effort (CPUE; fish/h) was calculated for each lake by dividing both species-specific and total catch at the lake by the hours of total angler effort. Additionally, 70-mm fluorescent orange T-Bar anchor tags were inserted into fish prior to release back into the water as part of a larger scale ongoing state-wide research project studying angler use of fish in alpine lakes.

Habitat surveys assessed limnological and morphological characteristics of lake, tributaries, and outlets. A visual assessment of salmonid spawning habitat availability was conducted at each lake and its inlets and outlets. Salmonid spawning habitat quality was qualitatively described based on substrate size, flow, and gradient.

Amphibian surveys were conducted by walking the perimeter of each lake and visually inspecting shoreline and near-shore habitats, including areas under logs and rocks. For amphibians detected, we recorded the species, number, and life stage. Life stages were classified as adult, juvenile, larvae, or egg.

Human use was evaluated based on general appearance of use, number and condition of campsite, number of fire rings, access trail conditions, trail distance, trail difficulty, and presence of litter. General levels of human use were categorized by IDFG staff as rare, low, moderate, and high based on an overall assessment of the factors described above.

RESULTS & DISCUSSION

Three lakes were surveyed in the Upper North Fork Boise River Basin in 2019. All Three lakes contained fish and amphibians.

Jennie Lake is located at the head of Bear Creek which flows into the Bear River and eventually into the North Fork of the Boise River. This lake is mesotrophic cirque lake with a NNW aspect. Accessible via a roughly three mile like along the Bear Creek trail, Jennie Lake receives high use as seven campsites and nine fire pits were observed around the lake. Because of its high use and relatively small size (2.1 ha), Jennie Lake is stocked with 500 Rainbow Trout fingerlings annually. Angler catch rates at Jennie Lake were low (Table 17) and the number of fish seemed low. However, there was evidence of natural reproduction as both Rainbow Trout and Rainbow Trout x Westslope Cutthroat Trout hybrids were encountered even though Westslope Cutthroat Trout have not been stocked the lake since 2009. A total of four Rainbow Trout (average 305 mm TL) were caught using hook and line sampling. Three of these fish received T-Bar anchor tags. A total of four Rainbow Trout x Westslope Cutthroat Trout Hybrids (average 298 mm TL) were also caught via hook and line sampling with all four of these fish receiving T-Bar anchor tags. Total CPUE for all fish sampled via angling was 0.53 fish/h. Amphibian surveys found one adult Columbia Spotted Frog, one adult Western Toad, and one adult Western Toad. Additionally, greater than 30 juvenile Columbia Spotted Frogs were observed.

Cow Lake is located at the head of Cow Creek which is a tributary to the North Fork Boise River. The lake is a mesotrophic moraine lake with a NE aspect. The Lake is accessed by a roughly 2.5 mile hike from Forrest Service Road 312 along the ridge between Horseshoe Creek and Little Silver Creek. The hike is mostly untrailed and is of moderate difficulty. Cow Lake is stocked with 750 Rainbow Trout on a two-year rotation and was last stocked in October of 2019. Prior to our August 2019 sampling, the most recent stocking was in September of 2017. Hook and line sampling in 2019 resulted in 12 trout being caught in Cow Lake. Ten were Rainbow Trout (average length 448 mm TL), one was a Rainbow Trout x Westslope Cutthroat Trout Hybrid (410 mm TL) and one was a Westslope Cutthroat Trout (350 mm TL). Westslope Cutthroat Trout have not been stocked in Cow Lake since 2008, indicating that there is some natural reproduction. Total CPUE at Cow Lake (0.80 fish/h) was the highest of the three lakes samples and the fish were the largest (Table 17). All 12 trout received a T-Bar anchor tag. Amphibian surveys found two adult and 10 juvenile Columbia Spotted frogs and 2 juvenile Western Toads. Cow Lake showed limited use with two camp sites and only partial trail access.

Big Buck Lake is located at the head of McKay Creek which is a tributary to the North Fork of the Boise River. The lake is a mesotrophic cirque lake with a NNW aspect. Access to Big Buck Lake is difficult. The best access to the lake is from the North Fork Boise River trailhead near Silver Creek. It is a roughly 2-mile hike up the North Fork to McKay Creek. From there, a 1.5-mile hike with a 1,600 foot elevation gain through untrailed broken/burned timber is required to reach the lake. Because of its remoteness and difficulty to reach, the lakes shows little to no signs of human use and no campsites or fire rings were observed. Big Buck Lake is stocked with 500 Rainbow Trout fingerlings on a three-year rotation with the most recent stocking occurring in September of 2019. The most recent stocking prior to our August 2019 sampling was September of 2016. Hook and line sampling resulted in catching nine Rainbow Trout (average 393 mm TL). All nine fish were tagged with a T-Bar anchor tag. Amphibian surveys found one adult Columbia Spotted Frog and one adult Pacific Chorus Frog.

DISCUSSION

The stocking for all three for these lakes should continue as is. Jennie Lake is highly utilized and while there appears to be some level of natural production, it appears limited. Annual stocking at this lake is justified given the high angler use.

Cow Lake is more remote and receives lower use. This has resulted in larger trout. Continued every two year stocking of this lake to provide additional fish for anglers is recommended. Because the road accessing the route to this lake was closed for a period of two years, decreased use of the lake might have been temporary. With the access road now open, higher use and fish exploitation might occur. Future monitoring will be valuable to assess this.

Big Buck Lake is unique in that it is very remote with no trail access and requires a strenuous hike. As such, it has high densities of nice trout. While it sees very limited use, it is important to continue to stock such lakes to provide high quality angling opportunities for those anglers willing to put in the extra effort to get away from the crowds. Therefore, despite its limited use, continued stocking on a three-year rotation is recommended.

RECOMMENDATIONS

1. Continue stocking all three lakes on the current schedule at the same stocking densities.

2. Resample lakes periodically to revisit if stocking strategies are still working effectively.

Table 16. Catalog Number, Lake Name, Sample Date and hook-and-line sampling information from surveys completed during 2019 in headwater tributaries to the North Fork Boise River. Trout species are abbreviated as follows: Westslope Cutthroat Trout (WCT), Rainbow x Cutthroat Trout hybrids (HYB), Rainbow Trout (RBT), and all species for a lake combined (ALL).

Catalog number	Lake name	Sample date	Species	Catch	Effort (h)	CPUE (Fish/h)	Mean length (mm)	Min length (mm)	Max length (mm)
10-0346	Jennie Lake	8/5/2020	RBT	7	16	0.44	305	250	350
			HYB	1	16	0.06	298	270	320
			ALL	8	15	0.53			
10-0355	Cow Lake	8/6/2020	RBT	10	15	0.67	448	445	490
			WCT	1	15	0.07	350	350	350
			HYB	1	15	0.07	410	410	410
			ALL	12	15	0.80			
10-0187	Big Buck Lake	8/7/2020	RBT	9	12	0.75	393	355	430

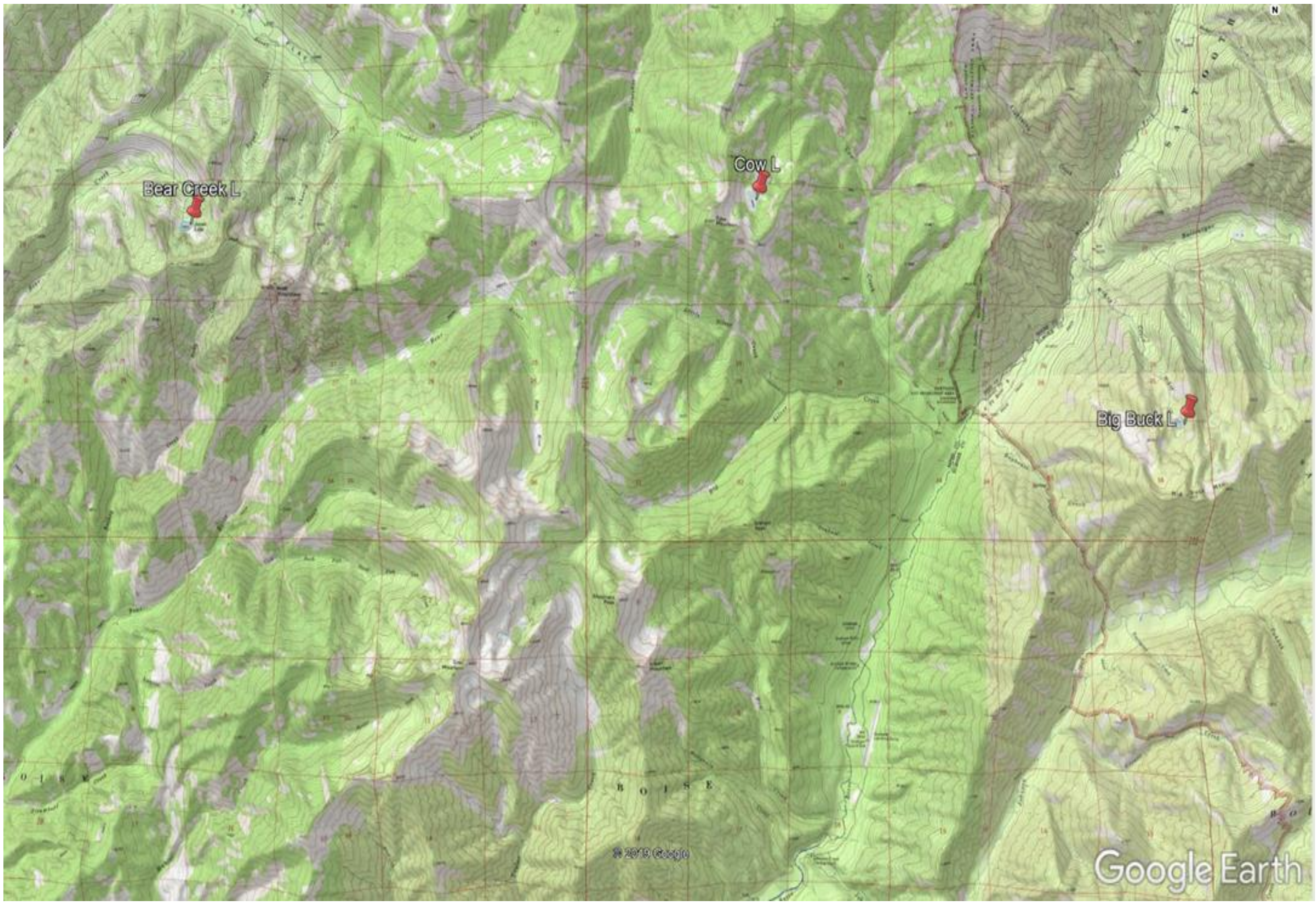

Figure 44. Location and names of alpine lakes sampled during 2019. Lakes were located in headwaters tributaries of the North Fork Boise River.

USE OF PESTICIDES TO CONTROL NUISANCE AQUATIC VEGETATION IN SMALL IMPOUNDMENTS

ABSTRACT

Excessive aquatic plant growth in Duff Lane pond was hampering fishing opportunities. In order to maintain fisheries quality, we treated the entire waterbody with aquatic herbicide (Navigate®, a granular 2, 4-D) at an application rate of 150 lb/acre. Submerged aquatic plant abundance was reduced by late summer. Effective long-term weed management will require vigilance and finding a balance between aquatic plant eradication and maintaining adequate amounts and types of aquatic plants for invertebrates and as cover for fish.

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INTRODUCTION

Idaho Department of Fish and Game's (IDFG) Southwest Region manages fisheries in about 50 publicly-accessible small ponds and reservoirs. These waters receive significant fishing effort and are an important resource for providing family-friendly opportunities. In some ponds, excess aquatic plant growth and coverage especially during the summer months may limit access or in extreme cases may totally preclude fishing. Furthermore, excess plant growth may create other problems such as high oxygen demand during decomposition or by providing too much cover for juvenile fish, leading to high abundances and small sizes. Excess plant coverage was reducing fishing opportunities in Duff Lane (5.5 acres) pond. Northern Watermilfoil *Myriophyllum sibiricum* was the predominant species present. Staff treated this pond with herbicide to reduce nuisance plant abundance and biomass.

METHODS

For aquatic plant management, we selected Navigate, a granular 2, 4 D, to treat this water, based on past efficacy and low fish toxicity. Recommended application rate for Northern Watermilfoil was 150 lb/surface acre. We used Google Earth to estimate surface acreage. Herbicide was applied using a granular fertilizer spreader mounted to the front of a small boat that was powered with an electric motor. On May 20, 2019, we treated the entirety of Duff Lane Pond with 800 lbs of Navigate. Additionally, Duff Lane Pond received 90 Grass Carp in June of 2019 as a means of further controlling the regrowth of the problem weeds.

RESULTS & DISCUSSION

The combination of herbicide treatment and grass carp was effective during 2019. Based on visual estimates, > 85% of rooted submerged vegetation was killed. No significant plant re-growth occurred at Duff Pond prior to fall. Continued effective aquatic plant management will require vigilance and finding a balance between plant eradication and maintaining aquatic plants for invertebrates and as cover for fish.

RECOMMENDATIONS

1. Monitor plant mortality and re-growth in ponds treated during recent years. Apply herbicide or stock Grass Carp on a semi-annual basis or as needed.

2. Monitor aquatic plant coverage in other waters that have a tendency to possess nuisance levels and initiate treatments where necessary.

RETURN-TO-CREEL AND TAGGING SUMMARY OF HATCHERY RAINBOW TROUT STOCKED IN 2018

ABSTRACT

Idaho Department of Fish and Game hatcheries remain integral to managing coldwater sportfishing opportunities in Idaho. With the initiation of the Tag-You're-It program, catch and harvest rates have been evaluated in numerous regional waters since 2006 and regional staff continue to work to collect tag return data for waters and stocking periods that have previously not been evaluated. In 2018, catchables stocked into three community ponds (Duff Lane, Heroes Park, and Williams Park) were tagged from March through December to evaluate seasonal angler use. In addition, stocking at Mountain Home Reservoir (April) was evaluated. A total of 682 catchables were tagged and released in the four study waters in 2018. Total catch ranged from a high of 110.0 ± 50.5% to a low of 0.0%. Similarly, days-at-large were also variable ranging from a high of 107 d to a low of 5 d. The Tag-You're-It program enables managers to collect a large amount of data with minimal costs and labor. We will continue to use this tool to further evaluate angler use of hatchery catchables in regional waters on an annual basis and make stocking adjustments to further maximize the angler use of hatchery catchable trout.

Author:

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Regional Fisheries Manager

INTRODUCTION

Idaho Department of Fish and Game (IDFG) hatcheries are integral to managing coldwater sportfishing opportunities in Idaho. The Southwest Region stocked approximately 255,000 “catchable” sized Rainbow Trout (10-12”*;* herein “catchables”) into 46 different waters in 2018. The majority of the catchables stocked in the Southwest Region are reared at the Nampa Fish Hatchery (>90%), with some coming from the Hagerman State Fish Hatchery (<10%). With the initiation of the Tag-You’re-It program (see Meyer and Schill 2014), catch and harvest rates have been evaluated in numerous regional waters since 2006. These waters have been stocked with tagged fish as part of regional evaluations or as part of larger scale statewide hatchery evaluation studies. More recently, regional staff has worked to “fill in the gaps” and tag fish destined for waters that have not been previously evaluated or where previous evaluations have raised questions about stocking strategies. Tag return information from these stockings continue to provide managers with valuable information that aids in adjusting or maintaining hatchery catchable stocking numbers at various waters throughout the region.

METHODS

Locations and stocking months identified as lacking tag return data that received tagged catchables in 2018 included Duff Lane Pond (March, May, June, and October), Heroes Park Pond (April, June, and October), and Williams Pond (February, June, October, and December). Additionally, Mountain Home Reservoir received tagged catchables in April.

Prior to stocking, roughly 10% of the fish to be stocked into study waters were tagged with 70-mm fluorescent orange T-bar anchor tags. Fish were collected for tagging by crowding them within raceways and capturing them with dip nets to ensure a representative sample. Fish were sedated, measured to the nearest mm, and tagged just under the dorsal fin. Within 24 h of tagging, tagged fish were loaded by dip net onto stocking trucks with the normal lot of untagged fish and transported to stocking locations.

Angler catch and harvest data was based on the anchor tags that were reported by anglers. For a detailed description of the angler tag reporting system used, see Meyer and Schill (2014). In short, anglers could report tags using the IDFG Tag-You’re-It phone system or website (set up specifically for this program), as well as at regional IDFG offices or by mail. To facilitate angler reporting of tagged catchables, anchor tags were labeled with “IDFG” and a tag reporting phone number on one side, with a unique tag number and reporting website on the reverse side. Year-specific tag reporting rates and shedding rates were generated by IDFG’s hatchery trout evaluation staff using a subset of $50 reward tags and double tagging a subset of fish.

Total angler returns (c) were calculated as the number of tagged catchables reported as caught within one year of stocking divided by the number of tagged catchables stocked. This included all catchables caught, including those released back into the fishery. Angler returns were evaluated within the first year post-stocking. Total angler returns were adjusted (c'), to estimate the total proportion of catchables caught by anglers for each stocking event, by incorporating the angler tag reporting rate (λ), tag loss (Tag_l), and tagging mortality (Tag_m); (which was taken from Meyer and Schill [2014] to be 0.8%). Estimates were calculated for each individual stocking event using the formula:

$$c' = \frac{c}{\lambda(1 - Tag_l)(1 - Tag_m)}$$

Finally, days-at-large of the catchables that were eventually caught post-stocking was calculated by subtracting the stocking date from the date that each angler reporting catching their tagged fish.

RESULTS

A total of 682 catchables were tagged and released in the four study waters in 2018. Total catch ranged from a high of 110.0 ± 50.5% for the June Heroes Park Pond stocking to a low of 0.0% for the June-Duff Lane Pond, April-Heroes Park Pond and the February and December-Williams Pond stockings. Similarly, days-at-large were also variable ranging from a high of 107 d for the October Duff Lane Pond stocking to a low of 5 d for the May Duff Lane Pond stocking. All tag release numbers and estimates of harvest and total catch can be located in Table 18.

DISCUSSION

Catch and harvest of hatchery catchables across waters and stocking periods remain variable and continued tag return information is further helping managers refine when and where to stock. Similar to previous years, the waters and dates for which fish were tagged in 2018 were targeted to answer specific questions related to data gaps in our previous tag return information. In order to collect meaningful data, the ponds were stocked across multiple months. Both Heroes Park and Williams ponds had no previous tag return data while Duff Lane Pond had not received tagged fish since 2013 and previous data showed poor angler use of hatchery catchables.

Duff Lane has moderate returns in the spring and fall but no use in the early summer. Data collected during this assessment, coupled with poor returns in previous evaluations, resulted in the decision to no longer stock hatchery catchable trout into Duff Lane Pond in June. This data suggest that water temperatures become too warm after stocking and the majority of fish likely die prior to being encountered by anglers. Also of interest was the average days-at-large. Fish stocked in the spring were caught within a couple weeks of stocking, while the fish stocked in October were at large for 107 days on average, indicating most were caught in the late winter or following spring.

Heroes Park Pond showed very high angler use of fish stocked in early summer and fall but no use of the spring stocking in April. Anecdotally, we know that this is a very popular pond with a high amount of angler effort throughout the year, as the pond is located adjacent to the busiest intersection in the state of Idaho according to the Ada County Highway District. Even though April tags showed no use, we will not make any stocking adjustments given the amount of effort at the pond and will evaluate spring stockings at this pond again in the future. This high amount of effort was also reflected in the 16 day average days-at-large for all stockings at this pond.

Williams Pond also showed variable returns with moderate use in the early summer and early fall, but little to no use in the winter. While the low returns in the winter months are not encouraging, winter fishing conditions, and subsequently winter fishing effort and success are highly variable. Given the single year of tag returns and the variability of winter fishing, we'd like to evaluate these returns further before making any suggested stocking modifications.

Historically, Mountain Home Reservoir has been stocked annually in April. Previous water management allowed for periodic carry-over of stocked trout resulting in a popular fishery that supported larger trout. However, more recently, the reservoir has been drawn down each year resulting in water levels too low for trout to survive. Prior to removing catchable trout stocking from this pond, we wanted to be sure these fish were being underutilized as a result of recent water management. Tag returns indicated this was the case, as only 5.5% of the fish stocked in the reservoir were harvested while 7.1% were caught. Because of these low returns and the continued low late summer reservoir pool, we will discontinue stocking Mountain Home Reservoir until the time that water conditions improve. Given that lack of fishing waters in the Mountain Home area, a portion of the fish that would have been destined for Mountain Home Reservoir will now be stocked into Legacy Park Pond in the Mountain Home city limits.

The use of T-bar anchor tags as a means to evaluate total catch and harvest across various regional waters will continue to be an important management tool. The Tag-You're-It program enables managers to collect a large amount of data with minimal costs and labor. We will continue to use this tool to further evaluate angler use of hatchery catchables in regional waters on an annual basis and make stocking adjustments to further maximize the angler use of hatchery catchable trout.

RECOMMENDATIONS

1. Discontinue June catchable stocking at Duff Lane Pond

2. Consider further evaluation of spring stocking at Heroes Park Pond

3. Consider further evaluation of winter stocking at Williams Park Pond

4. Discontinue stocking of catchable tour into Mountain Home Reservoir until the time that late summer/early fall water conditions and carryover improve

Table 17. Harvest and total catch (with 95% confidence intervals), and median days-at-large by waterbody and stocking month of hatchery catchable Rainbow Trout stocked in 2018.

Water	2018 stocking month	Number stocked	Harvest	95% CI	Total catch	95% CI	Median days-at-large
Duff Lane Pond	Mar	25	37.7%	27.6%	47.2%	30.3%	26
	May	24	0.0%	/	9.8%	15.1%	5
	Jun	25	0.0%	/	0.0%	/	/
	Oct	25	9.4%	14.5%	18.9%	20.2%	107
Heroes Park Pond	Apr	15	0.0%	/	0.0%	/	/
	Jun	15	78.6%	46.5%	110.0%	50.5%	20
	Oct	15	94.3%	48.9%	94.3%	48.9%	11
Mountain Home Reservoir	Apr	298	5.5%	3.3%	7.1%	3.8%	104
Williams Pond	Feb	50	0.0%	/	0.0%	/	/
	Jun	50	33.0%	18.8%	47.2%	22.1%	21
	Oct	50	18.9%	14.4%	18.9%	14.4%	10
	Dec	50	0.0%	/	0.0%	/	/

WARMWATER FISH TRANSFERS TO REGIONAL WATERS

ABSTRACT

As a means of supplementing populations and bolstering catch rates in regional waters, southwest regional personnel transferred four species of warmwater fish into seven waters in 2019. Supplemented waters included several community fishing ponds and Black Canyon Reservoir. Boat electrofishing was utilized to capture fish for transfer. A total of 879 fish were relocated including 60 Channel Catfish *Ictalurus punctatus*, 219 Largemouth Bass *Micropterus salmoides*, 250 Smallmouth Bass *Micropterus dolomieu*, and 350 Bluegill *Lepomis macrochirus*.

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INTRODUCTION

The Southwest Region contains over 40 small public community fishing ponds as well as nearly 40 lowland reservoirs. These fisheries offer a variety of angling options for both hatchery Rainbow Trout *Oncorhynchus mykiss* and several warmwater species. Nampa Hatchery regularly supplies Rainbow Trout to many of these area fisheries. However, warmwater fish populations are perpetuated by either natural reproduction or transfers from other waters. Idaho Department of Fish and Game (IDFG) seeks to maintain adequate populations of warmwater fish in many of these community ponds and reservoirs for recreational angling. In 2019, annual transfers of warmwater species to community fishing ponds were continued to provide put-and-take fishing opportunities.

In the winter of 2012-2013, the Bureau of Reclamation drew down Black Canyon Reservoir to complete a geological survey at the dam site. The draw-down transported a large but unquantified amount of sediment through the dam into the lower Payette River. Ultimately, these sediments and subsequent high turbidity caused high mortality for several fish species within the reach. While subsequent survey results indicated that relative abundance for several species had returned to levels observed in 2009 (Butts et al. 2011), Smallmouth Bass *Micropterus dolomieu* continued to decline (Peterson et al. 2019). Smallmouth Bass translocations occurred in Black Canyon Reservoir during 2019 to hasten population recovery and reestablish a viable fishery.

OBJECTIVES

1. Provide Channel Catfish *Ictalurus punctatus* fishing opportunity in community ponds.

2. Reestablish Smallmouth Bass populations in Black Canyon Reservoir and the lower Payette River, downstream of Black Canyon Dam.

METHODS

Sources of warmwater fish species included the public waters of C.J. Strike Reservoir and the Snake River adjacent to the Fort Boise Wildlife Management Area in Payette, Idaho. One private pond was also utilized at the landowner's request to remove adult Largemouth Bass *Micropterus salmoides* in order to improve population size structure. C.J. Strike Reservoir was used for Smallmouth Bass collections as this population has increased 78% since 2009 and remains a viable source for additional translocations within the region (Cassinelli et al. 2018).

Crews collected fish between June 4 and September 30, 2019 using an electrofishing boat equipped with a Midwest Lake Electrofishing Systems (MLES) Infinity system. The MLES was set at 20% duty cycle and 6,500-watt Honda generator supplied approximately 2,200 to 2,800 watts of pulsed DC power. Electrofishing occurred at night to increase catch. Dip nets were used to capture stunned fish which were then transferred to live cars and held until sufficient numbers were captured to fill a transport truck or trailer. Fish were then transported with supplemental oxygen at 1.5-2 liters/minute until they reached the release location.

RESULTS

During 2019, 879 fish were captured and transferred. This total included 60 Channel Catfish, 350 Bluegill *Lepomis macrochirus*, 250 Smallmouth Bass and 219 Largemouth Bass. Releases occurred in six community fishing ponds and Black Canyon Reservoir (Table 19).

Channel Catfish were transferred into one community pond complex located within the Southwest Region. This Channel Catfish transfer program began in 2008 and should be continued moving forward as they provide and additional sportfish opportunity at local community ponds during the summer months after suspending trout stocking because of warm water conditions.

RECOMMENDATIONS

1. Continue to monitor Smallmouth Bass relative abundance in the lower Payette River every 3-5 years to determine if additional releases are necessary to reestablish a sustainable population.

2. Continue transferring Channel Catfish to community fishing waters annually.

3. Continue stocking bass (both Smallmouth and Largemouth when available) and Bluegill into area ponds to supplement and promote population growth and angling.

Table 18. Warmwater fish transfers conducted in the Southwest region in 2019. Species codes are defined as CCF: Channel Catfish, LMB: Largemouth Bass, SMB: Smallmouth Bass and BLG: Bluegill.

Date	Collecting water	Receiving water	Spp. code	#	Mean weight (g)	Mean length (mm)	Release temp (°C)
6/4/2019	Snake River	Caldwell Rotary Pond	CCF	60	-	-	-
6/13/2019	Paddock Reservoir	Mariposa/Sterling Park Pond	LMB	35	-	281	23.9
6/13/2019	Paddock Reservoir	Esther Simplot Pond	LMB	37	-	281	18.3
6/21/2019	Indian Creek Reservoir	Mariposa/Sterling Park Pond	BLG	350	50	123	19.1
7/10/2019	Paddock Reservoir	Magnolia Park Pond	LMB	32	442	302	27.6
8/23/2019	C.J. Strike Reservoir	Black Canyon Reservoir	SMB	100	209	229	21.8
9/30/2019	C.J. Strike Reservoir	Black Canyon Reservoir	SMB	150	219	237	15.3
10/2/2019	Leroy Attwood private pond	Black Canyon Reservoir	LMB	51	453	320	12.7
10/3/2019	Leroy Attwood private pond	Beaches Pond	LMB	39	453	320	12.7
10/4/2019	Leroy Attwood private pond	Kleiner Pond - South	LMB	25	453	320	14.7

RIVERS AND STREAMS INVESTIGATIONS

LOWER BOISE RIVER

<u>ABSTRACT</u>

Standardized monitoring sites to estimate population size and size structure of adult wild Rainbow Trout *Oncorhynchus mykiss*, Brown Trout *Salmo trutta*, and Mountain Whitefish *Prosopium williamsoni* in the lower Boise River between Barber Park and the East Parkcenter Bridge have been sampled triennially since 2004. In 2019, approximately 3.2 km of the lower Boise River was sampled across four sites targeting Rainbow and Brown Trout. We captured 576 wild Rainbow Trout, 139 hatchery Rainbow Trout, and 43 Brown Trout across all four sites. Wild Rainbow Trout population estimates have varied since surveys began in 2004, with estimated population size in the lower Boise River peaking in 2010. Brown Trout are less abundant in the lower Boise River, and estimated population size from 2004 to 2019 has remained stable. Additionally, standardized monitoring sites to estimate relative density and size structure of juvenile wild Rainbow Trout and Brown Trout in the lower Boise River between Harris Ranch and Middleton have been sampled annually since 2015. In 2019, 64 sites were surveyed across 45 km. We captured 98 wild Rainbow Trout and 115 Brown Trout. Relative density estimates of juvenile wild Rainbow Trout decreased in 2019 compared to previous years, however juvenile Brown Trout density estimates increased.

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INTRODUCTION

The lower Boise River and its riparian corridor are valued for irrigation, recreation, and the inhabiting fish and wildlife. Prior to the 1970s, water quality and quantity were not conducive for sustaining quality fish populations. The Clean Water Act of 1972 and the resulting temperature and suspended sediment criteria acted as a catalyst for initiating water-quality improvements on the river. During the past 20-30 years, several agencies and municipalities have worked to improve water quality by improving agricultural and industrial practices as well as waste water, and storm water management.

The lower Boise River fishery supports substantial angling effort throughout the year (Kozfkay et al. 2010), supported primarily by both wild and hatchery-origin Rainbow and Brown Trout. Prior to establishing standardized monitoring sites in 2004, non-standardized sampling efforts on the lower Boise River captured few wild trout. More recent survey data and anecdotal information suggests that the number of wild Rainbow and Brown Trout in the river has improved over the last 20 years. Wild Rainbow Trout in particular have increased nearly seventeen-fold between 1994 and 2010 (Kozfkay et al. 2011). The increase in wild trout coincides with the establishment of minimum winter flows of 7 m^3/s in 1984. Wild trout populations were also likely enhanced by water quality improvements and an increase in catch-and-release practices over the same period.

In 2019 we completed the triennial long term population monitoring at our standardized sample locations for adult trout, as well as the annual long term juvenile trout sampling. The goal of this work was to monitor long term trends in wild trout population sizes and gain valuable knowledge of adult and juvenile species composition, relative density, and distribution throughout the lower Boise River.

STUDY AREA

The lower Boise River segment of the Boise River watershed begins at Lucky Peak Dam and continues for 103 km (64 mi) to its confluence with the Snake River near Parma, Idaho. The river flows through a variety of urban and agricultural settings and has been heavily affected by associated land and water uses (MacCoy 2004). Flows are regulated for both agricultural demands and flood control; while channel alteration has occurred throughout the system. Higher than natural flows generally occur between April and September (mean = 48 m^3/s) and lower than natural flows occur between October and March (mean = 14 m^3/s). Furthermore, there are approximately 28 diversions along the lower Boise River that supply water to various irrigation districts. There are approximately 14 major water inputs to the lower Boise River, including drains or tributaries, water treatment facilities, and irrigation returns. The surrounding land and water use practices have resulted in significant impacts on water quality and biological integrity including elevated sediment and nutrient levels, as well as increased water temperatures (MacCoy 2004).

Fish and invertebrate composition shifts from primarily coldwater-obligate species in the upper sections above Glenwood Bridge, to a warmwater species assemblage near Middleton and downstream to the Snake River, with a transition zone in between. Species present in the lower Boise River include Rainbow Trout *Oncorhynchus mykiss*, Brown Trout *Salmo trutta*, and Mountain Whitefish *Prosopium williamsoni*, and sculpin *Cottus sp.* in the upstream coldwater portion of the river. Warmwater species including Smallmouth Bass *Micropterus dolomieu*, Channel Catfish *Ictalurus punctatus*, and Common Carp *Cyprinus carpio* are found more frequently in the lower portion below Middleton, Idaho.

METHODS

Triennial Adult Trout Mark-Recapture Surveys

Trout and Mountain Whitefish populations in the lower Boise River have been monitored every three years since 2004 at two sites between Barber Park and the West Parkcenter Boulevard Bridge (Hebdon et al. 2009; Flatter et al. 2011, Koenig et al. 2015, Peterson et al. 2018). The upper site begins at the first diversion below Barber Park and continues down to the Loggers Creek diversion, less than 50 m upstream from the East Parkcenter Boulevard Bridge. The middle site starts at the Gallagher Canal diversion and stops downstream at the first riffle downstream of the confluence of Heron Creek (Figure 41). This site is within the reach managed with quality trout regulations (2-trout bag limit, none less than 360 mm). In 2016, a third site was added starting from the Ridenbaugh Canal diversion dam and ending at the Barber Park boat ramp. This site was added in order to monitor fish population response to habitat improvement work (Peterson et al. 2018) A fourth site was established in 2019 downstream near Eagle Island State Park to gain spatial resolution to salmonid populations downstream. Approximately 3.2 km of the lower Boise River was sampled in four sites with electrofishing gear in 2019 (Figure 41). Site lengths ranged from 280 to 998 m (Table 20). Wetted widths were measured with a hand-held laser range finder (Leupold RX series). Site area was estimated by multiplying the mean width (n = 10) and site length.

We used mark-recapture techniques to estimate population size of trout in all four sections. Fish were collected with a canoe electrofishing unit consisting of a 5.2-m Grumman aluminum canoe fitted with three mobile anodes connected to 15.2-m cables. The canoe served as the cathode and carried the generator, Midwest Lake Electrofishing Systems (MLES) Infinity electrofisher, and a livewell for holding fish. Oxygen was introduced to the live well (2 L/min) through an air-stone. Pulsed direct current was produced by a 5,000 watt generator (Champion 3500). Frequency was set at 25 - 30 pulses per second with a power output of 1,700 - 2,300 watts. Crews consisted of ten to thirteen people. Starting with the 2013 surveys, three mobile anodes have been used for each survey. Surveys conducted prior to 2013 utilized two mobile anodes. Three operators managed the mobile anodes, one person guided the canoe and operated the safety switch controlling the output. The remaining crew of six to nine people were equipped with dip nets to capture stunned fish. Only trout were placed in the livewell.

Marking and recapture runs were conducted with a single pass from upstream to downstream. The canoe was held upstream of the anode operators. Anodes were swept through the water or thrown across the stream and retrieved. Crews with dip nets walked backward facing upstream, while staying downstream of the anodes and capturing stunned fish. Fish were placed in the livewell and when the livewell was judged to be at capacity, the crew stopped at the nearest riffle to process fish.

Sites were sampled between October 22 and October 30, 2019. Fish were identified, enumerated and measured for total length (mm) and weighed (g). Rainbow Trout were examined to determine hatchery origin. Both Rainbow Trout and Brown Trout $\geq$100 mm were marked in the habitat and upper sites on October 22 and the middle and Eagle Island site on October 23. Fish were marked with a 7-mm diameter hole from a standard paper punch on the upper lobe of the caudal fin. Fish were released 50 to 100 m upstream from the processing site to prevent downstream displacement or resampling. Recapture sampling was completed on October 29 - 30. During the recapture effort all trout greater than 100 mm were captured and placed in the livewell. Fish were examined for marks on the caudal fin. All fish captured during the recapture sampling were measured for total length (mm).

Population estimates were calculated using Fisheries Analysis + (MFWP 2004) and Program R (RStudio Team, 2015). To account for size-selectivity of electrofishing gear, population estimates (*N*) were calculated using a maximum likelihood estimation to fit the recapture data. A capture probability function was calculated as:

$$Eff = (exp(-5+\beta_1 L+ \beta_2 L^2)) /(1+ exp(-5+\beta_1 L+ \beta_2 L^2))$$

where *Eff* is the probability of capturing a fish of length L, and β_1 and β_2 are estimated parameters (MFWP 2004). Then *N* was estimated by length group as:

$$N = M / Eff$$

where *M* is the number of fish marked by length group.

Population estimates were calculated for each reach and pooled for a comprehensive estimate expressed as # fish/100 m^2 for comparison to previous surveys. Trout population estimates ($\check{N}$) for surveys from which mark-recapture numbers were not adequate to use log-likelihood, were estimated using the modified Petersen equation for fish $\geq$100 mm shown as:

$$\check{N} = [((M+1)*(C+1)) / (R+1)] – 1$$

where *M* is the number of fish marked, *C* is the number of fish captured and *R* is the number of fish recaptured. Population estimates, length frequencies, and species composition were compared to results reported from prior surveys (Peterson et al. 2018, Koenig et al. 2015; Kozfkay et al. 2011; Hebdon et al 2009; Flatter et al. 2011; Allen et al. 1999).

To characterize the size distribution of Rainbow and Brown Trout captured during the survey and make trend comparisons between surveys, proportional size distribution (PSD) was calculated as:

$$PSD - X = \frac{Number\ of\ fish\ \geq specified\ length}{Number\ of\ fish\ \geq 250\ mm} \times 100,$$

where *X* was calculated for 305, 356, and 406-mm fish (Neumann et al. 2012). A minimum stock length of 250 mm is recommended for Rainbow Trout in lotic environments, but was used for both species to simplify results (Simpkins and Hubert 1996).

Annual Juvenile Wild Trout Surveys

Similar to 2018, juvenile Rainbow and Brown Trout production was evaluated at 64 sites from the Highway 21 Bridge to Middleton from November 4 to November 20, 2019 (Figure 41). These 64 sites were divided into 12 sample sections between lower Boise River mainstem and the associated tributaries. Most sections contained four sample sites, however the number of sample sites within a section ranged from one to five. Mainstem sites were stratified by river section with half of the mainstem locations selected randomly and the other half selected by crews. For the non-random sites, crews selected sites suspected to be high quality juvenile trout habitat based on visual habitat features such as near shore complexity, presence of woody debris or vegetation, and proper flow and depth. Additionally, nine sites were sampled in tributary/side channel habitat in Dry, Loggers, Heron, and Warm Creeks. In 2019, sites were 33-m long. During mainstem sampling, the area from the one shoreline out to approximately 4 m was sampled. For tributary/side channel sample sites, the entire channel was sampled. A single, upstream electrofishing pass was completed at each site.

Juvenile Rainbow and Brown Trout were sampled using a Smith-Root® LR-24 battery powered backpack shocker. Electrofishing voltage varied to produce approximately 100 – 120 watts, however duty cycle and hertz were held constant at 15% duty cycle and 60 Hz. All fish were identified, counted and measured for total length. Relative fish densities (fish/m^2) ± 95% confidence intervals were calculated.

RESULTS

Triennial Adult Trout Mark-Recapture Surveys

Across all four sites combined, we captured 576 wild Rainbow Trout, 139 hatchery Rainbow Trout, and 43 Brown Trout during the 2019 mark-recapture survey (Table 20). Wild Rainbow Trout made up approximately 75% of the trout caught in the four sites and Brown Trout made up 18% of the trout captured.

Across all four sites combined, we estimated a total trout (Brown and Rainbow Trout) population size of 6,485 ± 34 fish. We estimated wild Rainbow Trout population across the entire reach to be 3,110 ± 722 fish. We estimated Brown Trout population across the entire reach to be 153 ± 77 fish (Figure 42).

Site-specific population estimates for all species combined varied from 564 ± 193 fish (Middle), 848 ± 360 fish (Upper), 854 ± 271 fish (Eagle South) to 3,195 ± 2,264 fish (Habitat; Figure 43).

Species-specific population estimates also varied at the different sites. Wild Rainbow Trout population estimates were 1,720 ± 1,435 fish in the habitat reach, 582 ± 240 fish in the Upper reach, 493 ± 189 fish in the Middle reach and 765 ± 256 fish in the Eagle South reach. Brown Trout population estimates were 11 ± 8 fish in the Habitat reach, 13 ± 12 fish in the Upper reach, 44 ± 24 fish in the Middle reach and 63 ± 49 fish in the Eagle South reach (Figure 44). Hatchery Rainbow Trout populations in the lower Boise River are supported by stocking, which occurred during our mark-recapture efforts, violating our closed population model assumptions. As such, hatchery Rainbow Trout population estimates were not calculated.

Rainbow Trout total length ranged from 76 to 602 mm, (mean = 245.5 mm, SE = 3.6 mm; Figure 45). Brown Trout total length ranged from 104 mm to 680 mm (mean = 334.8 mm, SE = 22.1 mm; Figure 46). Overall Rainbow Trout PSD-305 was 55, PSD-356 was 25 and PSD-406 was 10. Overall Brown Trout PSD-305 was 27, PSD-356 was 21 and PSD-406 was 0. Rainbow Trout PSD-305 mm was highest in the upper section while PSD-356 mm and PSD-406 was highest at the Eagle South site. Brown Trout PSD-305 was highest at the Eagle South site, while PSD-356 was highest at the upper site (Table 21).

Estimated wild Rainbow Trout population size has fluctuated over time. In the middle reach, which has been most regularly sampled from 2004 to 2019, wild Rainbow Trout population estimates increased from 2004 to 2010, remained relatively stable from 2010 to 2016 and decreased in 2019 (Figure 53). Estimated Brown Trout population size in the lower Boise River has also fluctuated over time yet remains much lower than estimated wild Rainbow Trout population size. Wild Brown Trout population estimates have decreased from 2004 to 2010, increased in 2013 but have decreased since (Figure 53).

Additionally, lower Boise River Rainbow Trout length structure has varied over time. Generally, from 2004 to 2019, PSD-305 mm, PSD-356 mm, and PSD-406 mm all steadily increased. Lower Boise River Brown Trout length structure has also varied over time, however following an opposite trend. Generally, from 2004 to 2019, PSD-305 mm, PSD-356 mm, and PSD-406 mm all decreased (Figure 54).

Annual Juvenile Wild Trout Surveys

Many different species were observed during juvenile trout surveys, including dace sp., sculpin sp., and sucker sp. (Table 22). A total of 115 Brown Trout and 98 Rainbow Trout were captured during the survey. Brown Trout catch ranged from 0 to 89 fish per site, while Rainbow Trout catch ranged from 0 to 26 fish per site (Table 22). Rainbow Trout lengths ranged from 73 to 425 mm (mean = 111.3 mm, SD = 51.2*;* Figure 47) and Brown Trout lengths ranged from 72 to 296 mm (mean = 120.8 mm, SD = 36.7*;* Figure 48).

Juvenile trout densities varied by location, habitat type, and species in 2019. Mean density of juvenile Rainbow Trout was 0.02 ± 0.01 fish/m^2 for the entire survey. Mean density of juvenile Brown Trout was 0.01 ± 0.02 fish/m^2 for the entire survey (Figure 49). Mainstem sites typically had lower densities than tributary/side channel sites (Figure 50). In mainstem sites, mean density of juvenile Rainbow Trout was 0.02 ± 0.01 fish/m^2 while tributary/side channel sites had a mean density of 0.01 ± 0.03 fish/m^2. Mean density of juvenile Brown Trout was 0.01 ± 0.01 fish/m^2 in mainstem sites and 0.04 ± 0.14 fish/m^2 in tributary/side channel sites (Figure 51). In the mainstem, the highest densities of Rainbow Trout were sampled upstream of Eagle (Harris Ranch & Barber Park), whereas the highest densities of Brown Trout were sampled downstream of Eagle (Star*;* Figure 51). For tributary/side channel sites, juvenile Brown Trout density was highest in Loggers Creek. There were very few juvenile Rainbow Trout captured in tributary/side channel habitats in 2019.

DISCUSSION

Triennial Adult Trout Mark-Recapture Surveys

The lower Boise River wild Rainbow Trout population plateaued in 2010 after over two decades of population increases. The remarkable increase in wild Rainbow Trout population size coincided with the establishment of a minimum winter flow in the mid-1980s. Low winter flows have been shown to inhibit survival of juvenile trout in numerous systems (Hurst 2007; Mitro 2003). In addition, water quality has improved and catch-and-release practices have become more prevalent during the same period. However, wild Rainbow Trout abundance has now declined since 2010. At this time, the cause of the recent decline in estimated lower Boise River wild Rainbow Trout population size is unknown but the Department will continue to monitor the population in the future. Estimates in the lower Boise River may be caused by biological variables or sample design limitations. With different reaches sampled, comparisons across multiple sampling years at the river-wide level can be misleading. However, the proportion of larger wild Rainbow Trout continued to increase. Conversely, the fluctuations we observe in wild Brown Trout populations are likely due to the relative scarcity of Brown Trout in the lower Boise River (Brown Trout were 18% of the total catch in 2019). With small sample sizes and low recapture rates, a few fish caught or missed can have a larger impact on the population estimate.

Lower Boise River adult trout population estimates provide fishery managers insight at the species, site and reach scale, however, the confidence intervals surrounding some estimates are quite wide. Wide confidence intervals surrounding the hatchery Rainbow Trout population estimates are likely an artifact of violated closure assumptions between the mark and recapture runs. However, the wide confidence intervals surrounding wild Rainbow Trout and Brown Trout may be attributed to sampling efficiency. The 2019 survey was the third mark-recapture survey of the trout populations in the lower Boise River using three anodes. Prior to 2013, the triennial survey was conducted using two anodes. There was a marked increase in capture efficiency between the 2010 and 2013 surveys when switching to the three anode system (Koenig et al. 2015) and the capture efficiencies remained similar in 2019. However, despite the increases in capture efficiencies when adding the third anode, overall capture probability in 2019 remained less than 0.2. Theoretically, additional anodes may further increase capture probability and thus decrease confidence bounds around the lower Boise River population estimates. However, more than three anodes would be logistically difficult and likely not an option. Capture probability is also directly influenced by the number and/or tenacity of netters per anode. Additional netters or more tenacious netters may be a better option than increased anodes. However, each section contained deep holes which were inaccessible for a foot-based sampling crew, no matter the anodes or personnel. Finally, size-selectivity and gear-biases are well-documented in electrofishing surveys (Meyer & High 2011, Riley & Fausch 1992). These biases are evident in our survey as well. For both wild Rainbow Trout and Brown Trout, capture probability increases with fish total length, yet the highest capture probability is only 0.41 and 0.25, respectively. Based on our maximum likelihood estimates, we either over-estimate or under-estimate capture probability based on size category. As mentioned above, survey techniques may need to be adjusted to account for such biases. These issues suggest areas for continued improvement to further standardize and improve surveys moving forward. While still in its infancy, IDFG Regional Fisheries staff has proposed a larger-scale evaluation working cooperatively with IDFG Fisheries Research staff to better estimate fish populations in large rivers.

The Barber Park Habitat Improvement Project was one of the first large-scale aquatic habitat improvement projects in the mainstem lower Boise River. Completed in 2016, the project was completed on time, within budget and considered an administrative success. The 2019 survey was the first triennial survey completed post-project. While comparisons between estimated populations in the Habitat reach from 2016 to 2019 show a slight decrease in estimated population size, this signal is confounded by the wide confidence intervals, and the population estimate is on the same order of magnitude across the two sampling events. We will continue to monitor the progress of fish populations in the Barber Park reach and look for feasible opportunities to continue to improve fish habitat in the lower Boise River

Despite the fluctuations and wide confidence intervals, the 2019 survey indicates that the wild trout populations in the lower Boise River appear to have a growing population of larger trout. The increase in large individuals bodes well for Boise River anglers and may be influenced by the low exploitation of wild trout. In 2015 – 2016, IDFG staff conducted a survey utilizing the “Tag You’re It” program to estimate angler exploitation and use of trout in the lower Boise River. Based on the results from that survey, angler exploitation and use of wild trout in the lower Boise River was low. Only 5.5% of tagged Rainbow Trout were caught and 2.4% were harvested, while 16.1% of Brown Trout were caught and 0% were harvested within one year of tagging. Since this survey, the population of Idaho's Treasure Valley has increased by nearly 100,000 residents. As such, we anticipate repeating this angler exploitation and use survey in 2020 – 2021.

Hatchery Rainbow Trout were again captured in the lower Boise River adult trout surveys. Between 200-500 triploid hatchery Rainbow Trout are stocked monthly near the sample areas. During 2019, the stocking occurred in-between the mark and recapture runs, violating our population closure assumption. This is especially evident through the confidence intervals surrounding the population estimate overlapping zero. Hatchery Rainbow Trout population size has varied historically which can likely be attributed to both high angler exploitation, and poor survival of stocked fish in lotic systems beyond 14 days (High and Meyer 2009). In 2013, extensive tagging of hatchery Rainbow Trout in the lower Boise River showed a mean angler catch rate of 46.4% and a harvest rate of 31.7%.

Annual Juvenile Wild Trout Surveys

The continuation of the fall shoreline surveys for juvenile trout offered further insight into identifying important juvenile trout habitats in the lower Boise River. Fall densities of juvenile Rainbow Trout were lower in 2019 compared to 2018. These fry densities are relatively low when compared to the SF Boise River, where fall fry densities average 2 fish/m^2 (Butts et al. 2016). We speculate the decrease in observed juvenile Rainbow Trout densities can be correlated to a high-flow event sustained in the Boise River during early June. On June 3rd, 2019, the flow in the lower Boise River increased nearly 1,700 cfs in a matter of hours from approximately 3,500 cfs to approximately 5,200 cfs. This increased flow lasted until June 7th, 2019. This pulse occurred while juvenile Rainbow Trout are in a very vulnerable development stage, and likely impacted recruitment. The Department will continue to coordinate with water users in an attempt to avoid additional incidents.

Habitat preferences and subsequent habitat segregation in salmonids is well studied (Hearn 1987, Gatz et al. 1987, Bozek & Hubert 1992). The annual juvenile trout survey showed spatial differences between juvenile Rainbow and Brown Trout in the lower Boise River. Wild juvenile Rainbow Trout densities are highest in areas upstream of Eagle. In contrast, wild juvenile Brown Trout densities are highest downstream of Eagle. Tributary/side channel habitats had higher relative densities of juvenile Rainbow and Brown Trout than mainstem sites. The lower Boise River has been extensively developed and channelized, resulting in decreased tributary/side channel habitats compared to a less urbanized river like the South Fork Boise River. Heron Creek, where high densities of juvenile Rainbow Trout have been found historically is only about 60 m in total length. In 2009, the local Trout Unlimited (TU) chapter completed a habitat improvement project in Heron Creek. Members removed six yards of accumulated sand and fine sediment and placed appropriately-sized gravel for spawning substrate. We speculate that this project increased trout densities at this location, though it is not possible to draw a direct causative link as no pre-project data was collected. Finding additional opportunities to improve larger sections of tributary/side channel or connected floodplain habitat would be beneficial for lower Boise River trout populations. A better understanding of the specific habitat differences that influence species-specific recruitment may benefit fishery management and future habitat enhancement efforts in the lower Boise River. Future work might include correlating species-specific densities and CPUE info from the shoreline surveys to specific habitats within the lower Boise River.

The triennial mark-recapture surveys conducted on the lower Boise River since 2010 have provided fishery managers significant insights into lower Boise River wild Rainbow and Brown Trout populations. With increased knowledge of the spatial distribution of wild trout populations, a better understanding of habitat and flow characteristics correlated with areas of better fry and adult populations would be beneficial. Identifying specific habitats correlated with higher populations of both juvenile and adult wild trout will help with future habitat work.

RECOMMENDATIONS

1. Continue triennial adult trout population monitoring in the lower Boise River.

2. Continue annual fall surveys to continually monitor annual variability in juvenile trout densities.

3. Repeat the raft electrofishing survey in summer 2020 to further evaluate population size and angler exploitation of wild Rainbow and Brown Trout in the lower Boise River.

Table 19. Section, species, number captured and marked (mark run) and number captured and recaptured (recapture run) at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey. Mark-recaptures population estimates were conducted in all four sites.

Section	Species	# Captured (mark run)	# Marked	# Captured (recapture run)	# Recaptured
Habitat	WRBT	97	84	80	3
Upper	WRBT	91	91	94	14
Middle	WRBT	169	160	45	14
Eagle South	WRBT	120	112	155	22
Habitat	BNT	3	3	5	1
Upper	BNT	1	1	6	0
Middle	BNT	14	14	14	4
Eagle South	BNT	11	11	15	2
Habitat	HRBT	53	53	50	1
Upper	HRBT	14	14	18	0
Middle	HRBT	4	4	0	0
Eagle South	HRBT	1	1	0	0

Table 20. Species and proportional stock density (PSD) for different length categories for wild Rainbow Trout and Brown Trout at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

Species	PSD-305 mm	PSD-356 mm	PSD-406 mm
WRBT	55	25	10
BNT	28	21	0

Table 21. Number of individuals captured by species at all sites surveyed in the lower Boise River during the fall 2019 annual juvenile trout surveys.

	Reach																	
Species	Americana	Barber	Can-Ada	Dry Cr	Eagle North	Eagle South	Glenwood	Harris Ranch	Linder North	Loggers Cr	Morrison	Plantation	Special Reg	Star	Star North	Star South	Warm Cr	Total
Bluegill	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3
Bridgelip Sucker	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Brown Trout	1	0	1	0	4	0	0	0	1	89	4	2	0	2	10	0	1	115
Dace (Var. Sp.)	4	4	0	1	4	1	3	0	1	3	1	2	3	0	1	1	0	29
Green Sunfish	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Largemouth Bass	2	0	0	0	2	1	3	0	0	2	1	0	0	2	2	2	0	17
Largescale Sucker	0	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	4
Mountain Whitefish	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	3
Northern Pikeminnow	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	5
Oriental Weatherfish	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Wild Rainbow Trout	2	23	2	0	1	0	0	21	2	0	26	4	13	0	0	0	4	98
Rainbow Trout	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	12
Hatchery Rainbow Trout	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Redside Shiner	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sculpin (Var. Sp.)	4	4	0	0	3	2	3	2	1	3	4	3	2	0	0	0	1	32
Sucker (Var. Sp.)	0	0	4	2	0	0	0	4	1	1	0	0	0	4	3	2	0	21
Total	14	34	10	4	17	4	9	28	6	112	36	12	18	11	19	6	6	346

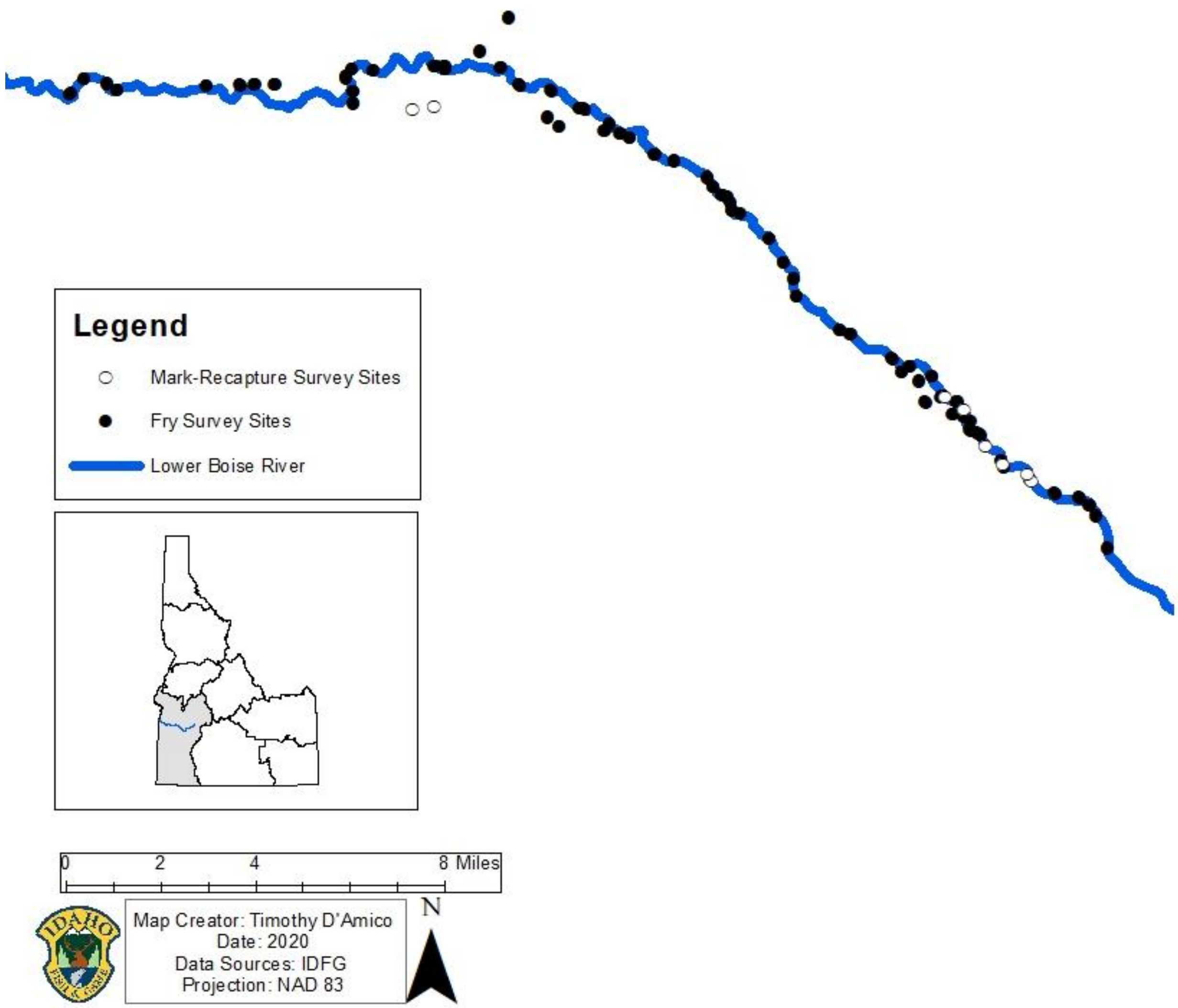

Figure 45. Map of the lower Boise River, Idaho sampling sites showing survey reaches for the 2019 triennial adult trout mark-recapture survey as well as 2019 annual juvenile trout surveys.

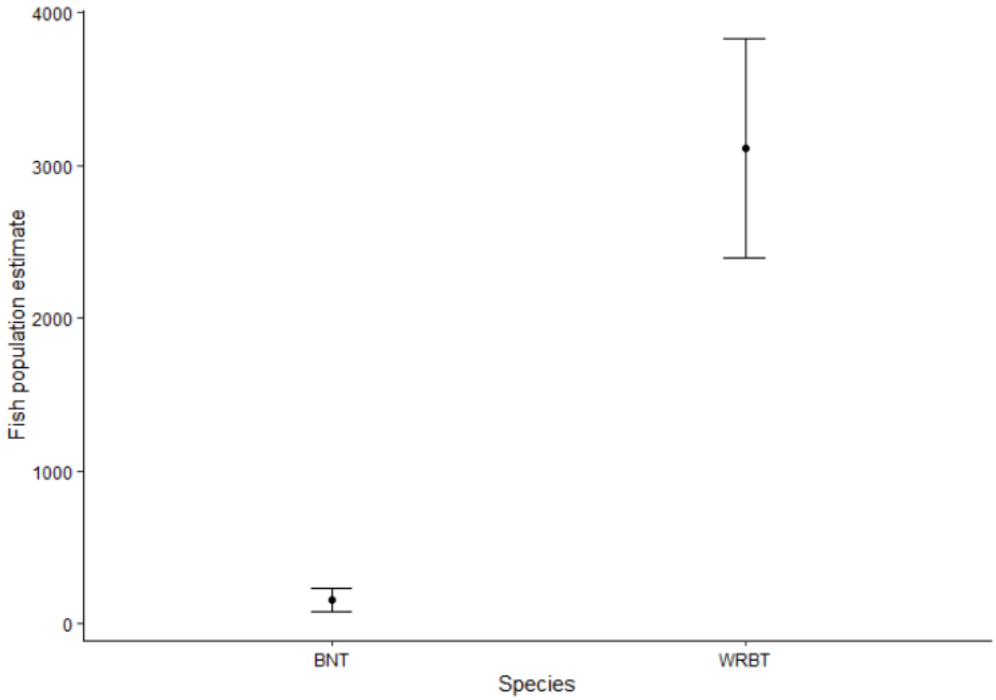

Figure 46. Brown Trout (BNT) and wild Rainbow Trout (WRBT) estimated population size of fishes captured at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

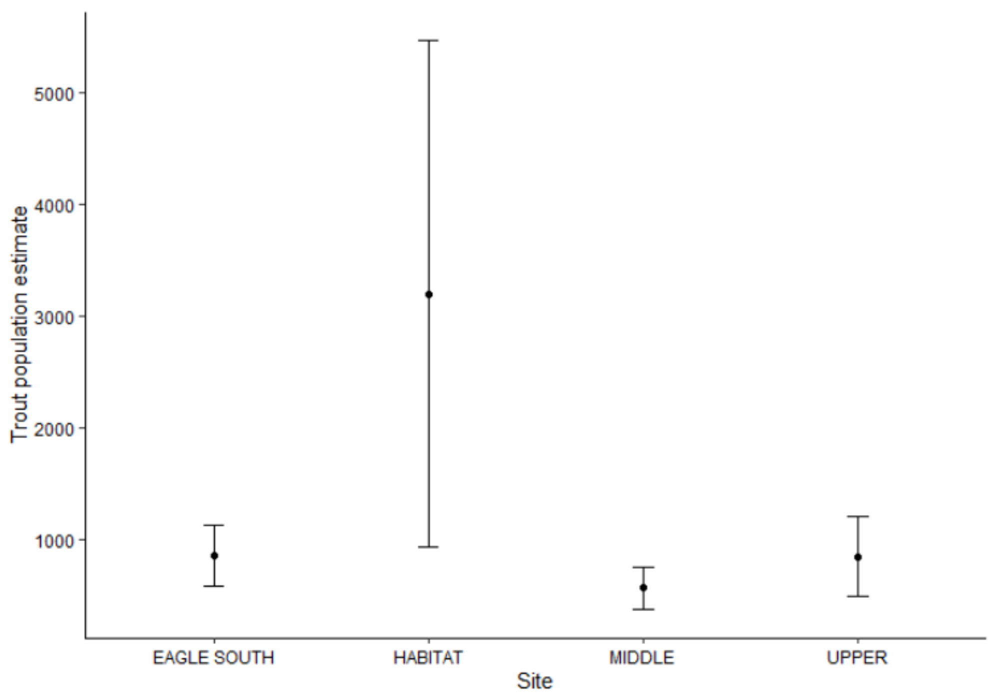

Figure 47. Estimated population size of trout (wild Rainbow Trout and Brown Trout combined) captured by reach at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

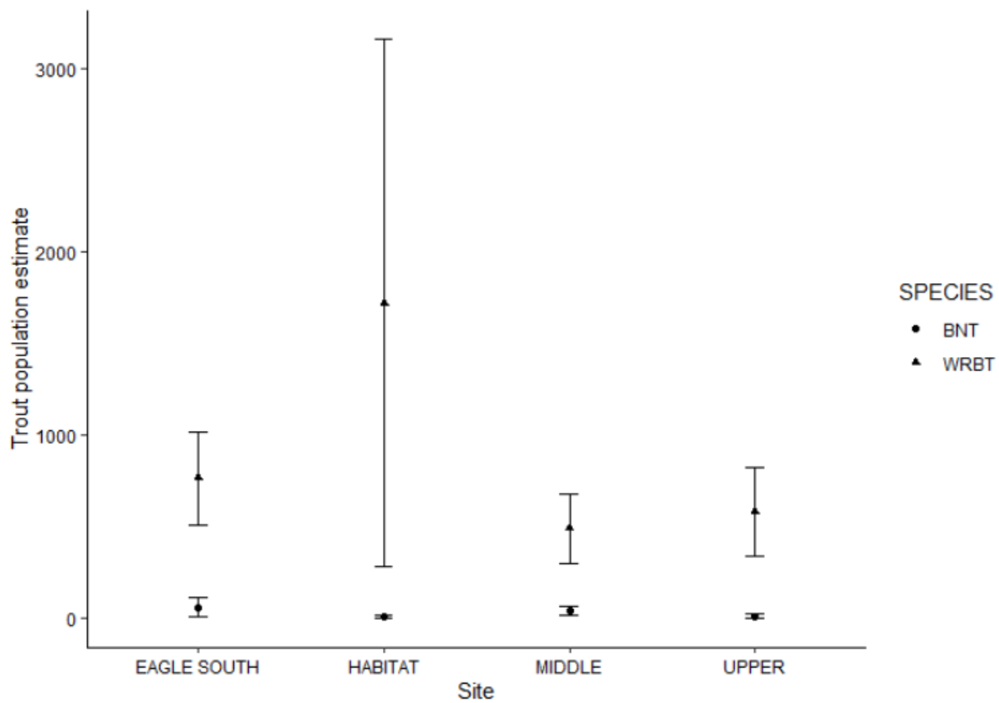

Figure 48. Estimated population size by site for Brown Trout (BNT) and wild Rainbow Trout (WRBT) collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

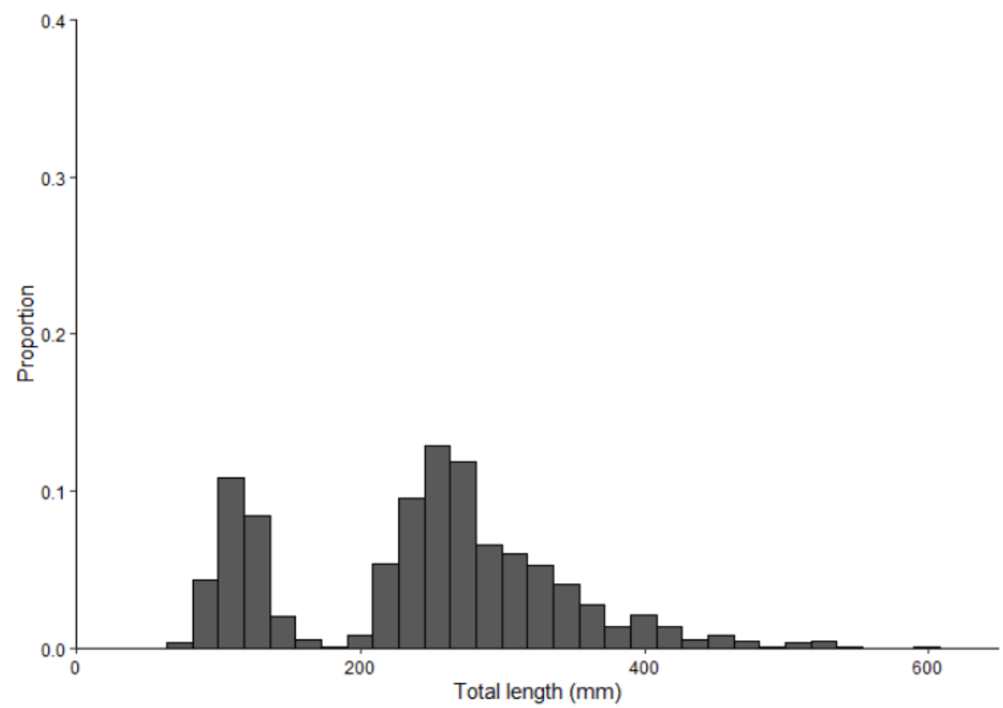

Figure 49. Proportional length frequency distribution of wild Rainbow Trout collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

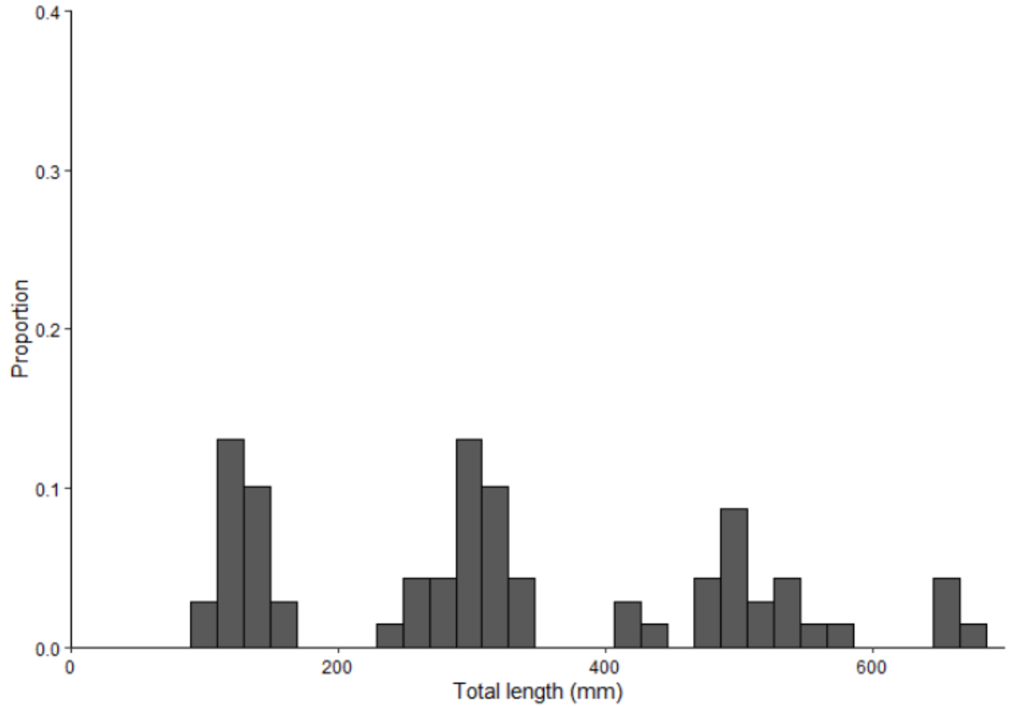

Figure 50. Proportional length frequency distribution of Brown Trout collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey.

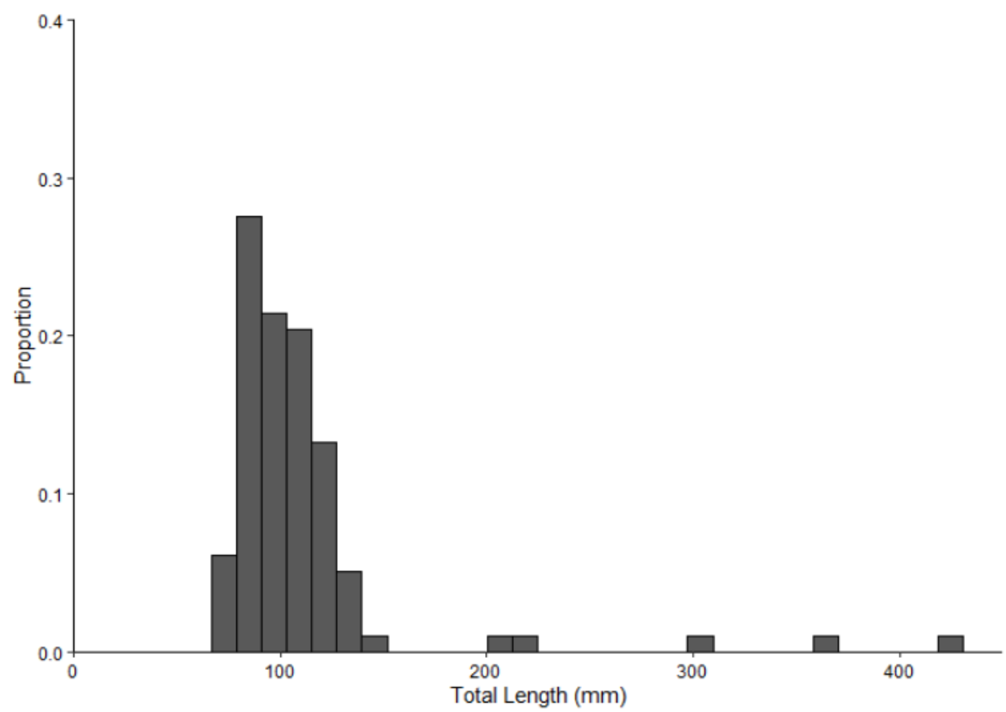

Figure 51. Proportional length frequency histogram of wild Rainbow Trout collected at all sites surveyed in the lower Boise River during the fall 2019 annual juvenile trout surveys.

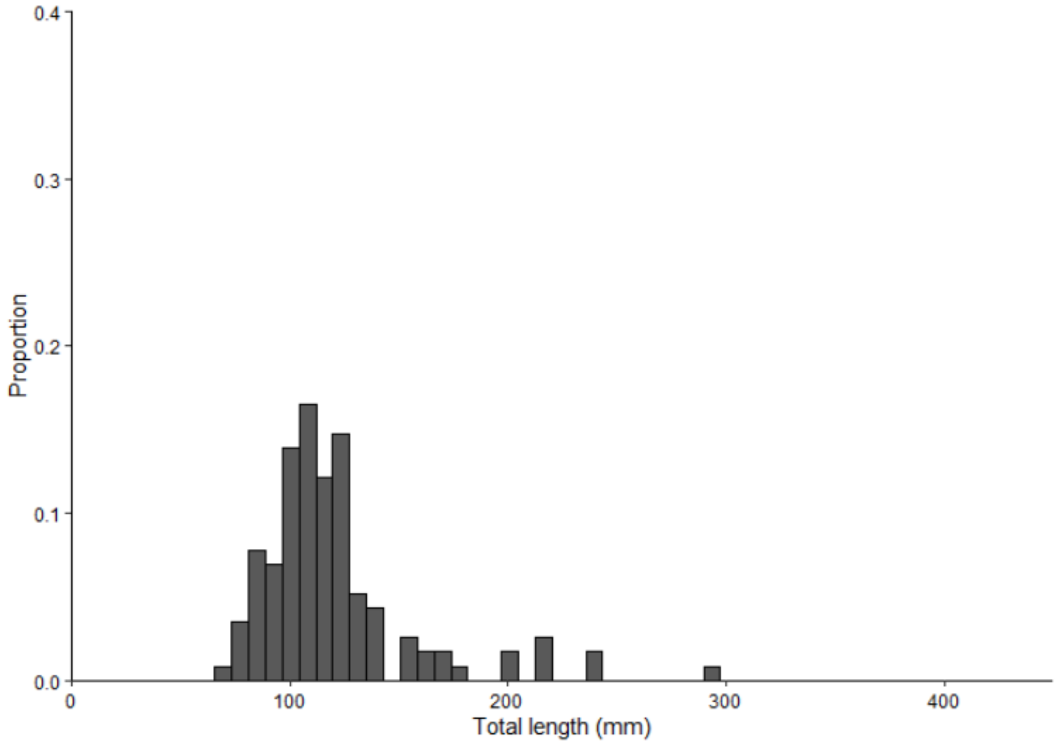

Figure 52. Proportional length frequency histogram of Brown Trout collected at all sites surveyed in the lower Boise River during the fall 2019 annual juvenile trout survey.

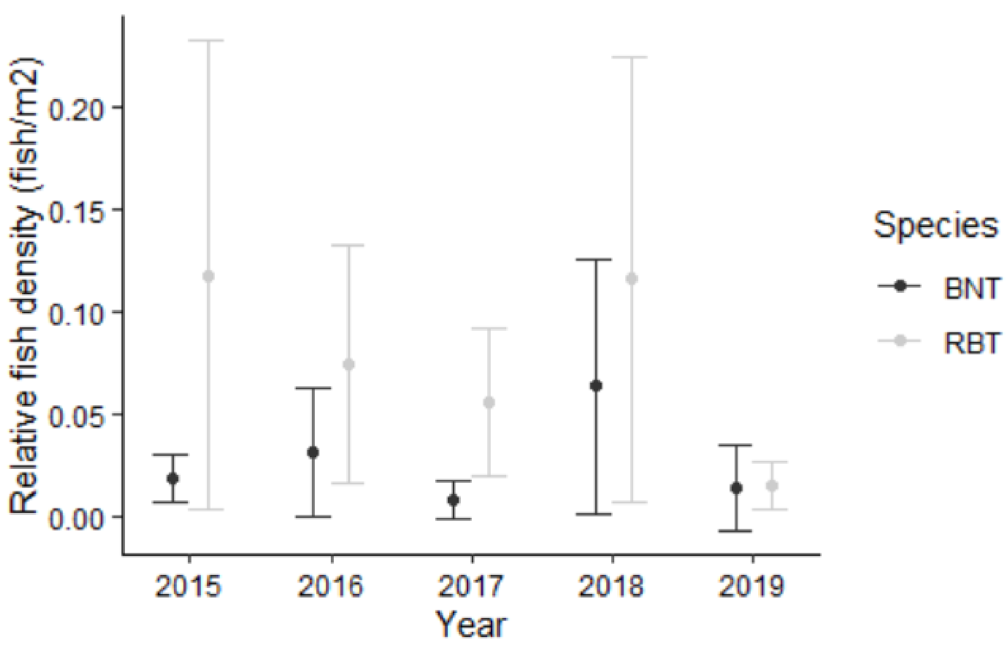

Figure 53. Relative density (fish/m^2) for Brown Trout (BNT) and Rainbow Trout (RBT) collected at all sites surveyed in the lower Boise River during 2015 - 2019 fall annual juvenile trout surveys.

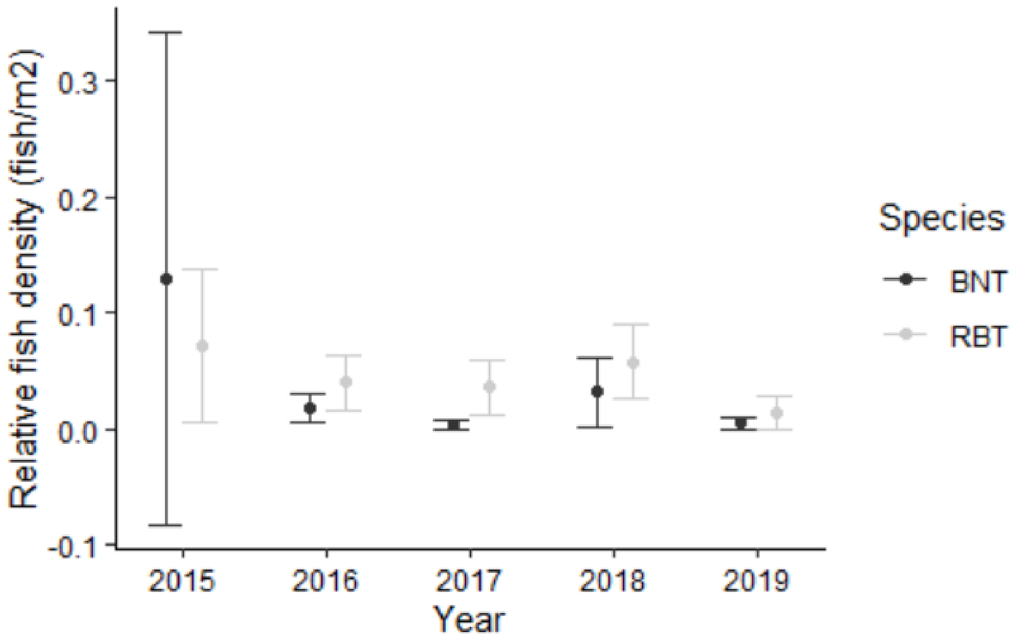

Figure 54. Relative density (fish/m²) for Brown Trout (BNT) and Rainbow Trout (RBT) collected in the mainstem sites in the lower Boise River during 2015 - 2019 fall annual juvenile trout surveys.

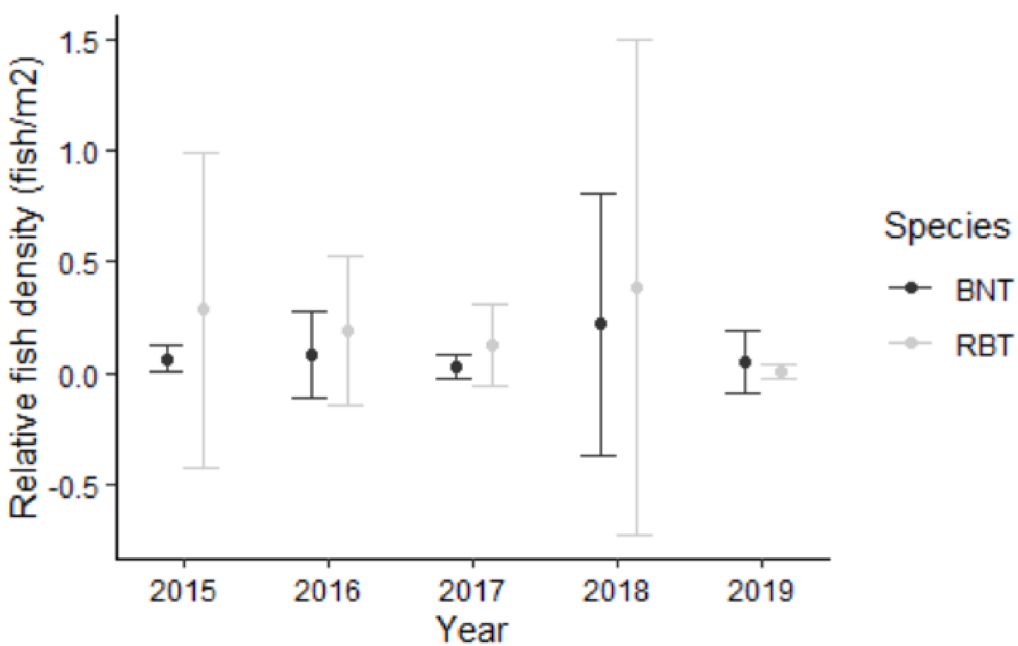

Figure 55. Relative density (fish/m²) for Brown Trout (BNT) and Rainbow Trout (RBT) collected in the tributary/side channel sites in the lower Boise River during 2015 - 2019 fall annual juvenile trout surveys.

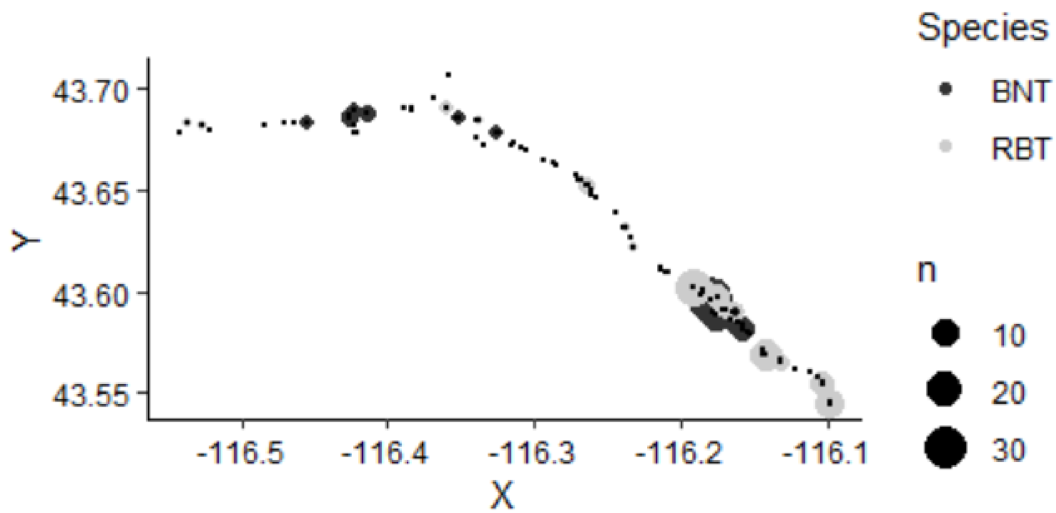

Figure 56. Spatial distribution of Brown Trout (BNT) and Rainbow Trout (RBT) collected in the lower Boise River during the 2019 fall annual juvenile trout surveys.

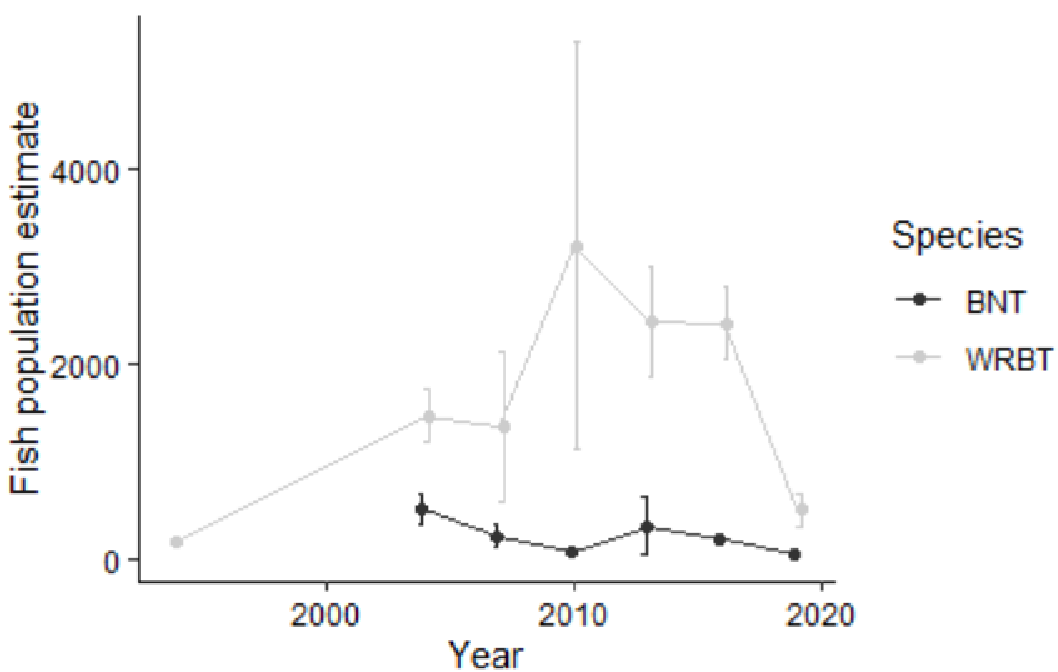

Figure 57. Estimated population size of Brown Trout (BNT) and wild Rainbow Trout (WRBT) collected in the Middle survey site of the lower Boise River during 2004 – 2019 triennial adult trout surveys.

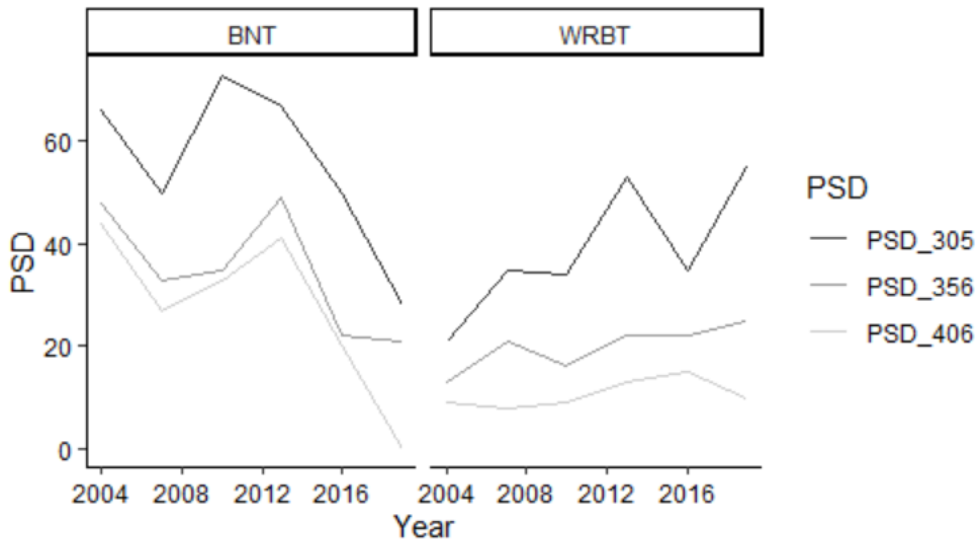

Figure 58. Proportional size distribution for Brown Trout (BNT) and wild Rainbow Trout (WRBT) in different PSD categories (shown by shade) collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey. For the proportional stock density, stock length was 254 mm.

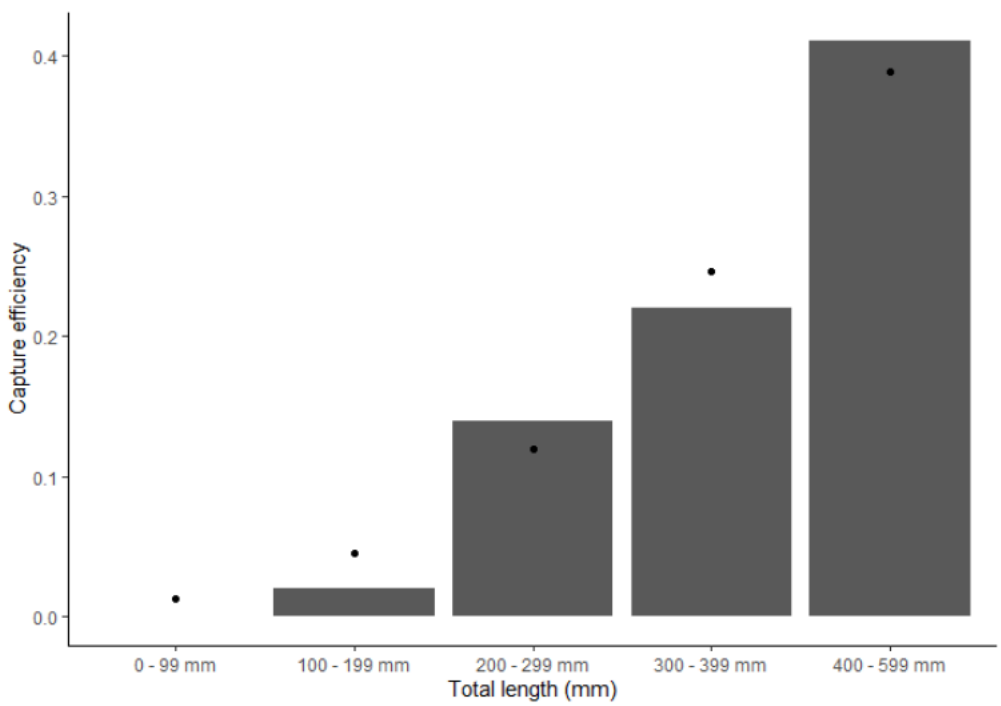

Figure 59. Capture probability for wild Rainbow Trout collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey. Modeled capture probabilities (based on maximum likelihood estimates) are shown by black points, actual capture probabilities (based on mark-recapture data) are shown by grey bars.

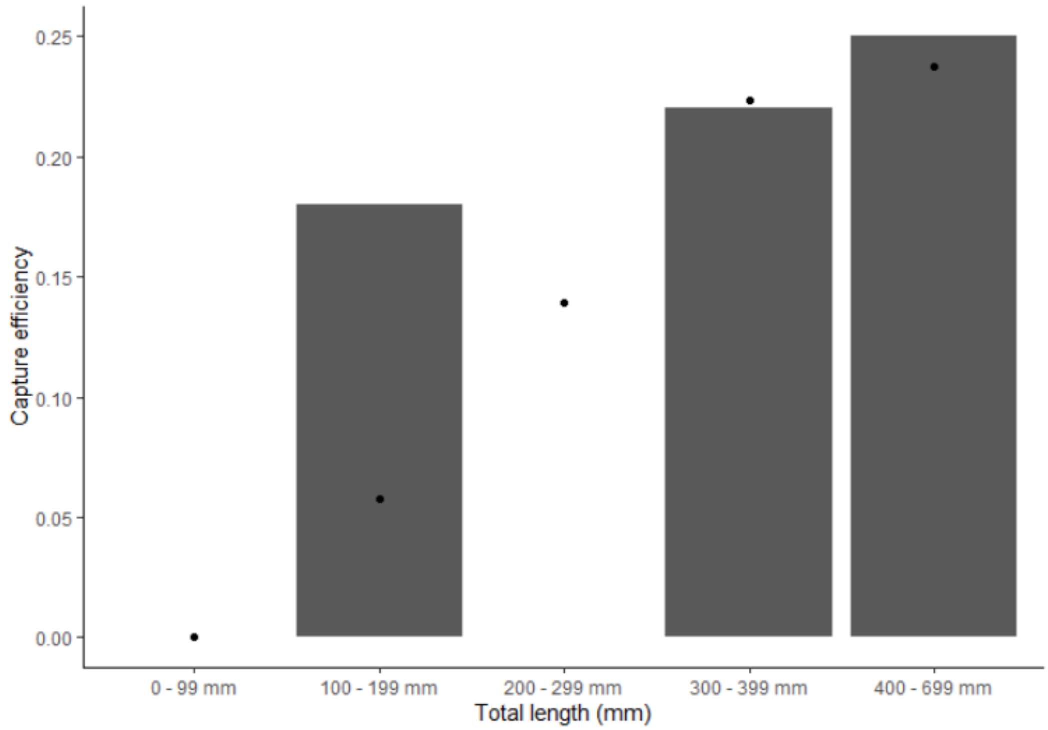

Figure 60. Capture probability for Brown Trout collected at all sites surveyed in the lower Boise River during the October 2019 triennial adult trout survey. Modeled capture probabilities (based on maximum likelihood estimates) are shown by black points, actual capture probabilities (based on mark-recapture data) are shown by grey bars.

NORTH FORK BOISE RIVER SNORKEL SURVEYS

ABSTRACT

During summers 2017 - 2019, fifteen historic trend sites were surveyed in the North Fork Boise River (NFBR) using entire-width snorkeling. Trends in relative abundance were compared using species-specific density estimates for each site and comparing amongst years and river sections. There remains a strong correlation in densities among the various species observed in the NFBR among sample periods. There also remains a strong positive correlation between wild Rainbow Trout *Oncorhynchus mykiss* (WRBT) densities and average stream flow across the three years prior to sampling. Due to the limited accessibility and generally low densities of WRBT the upper and lower sections of the NFBR support limited fishing effort. The majority of the angling effort occurs in the middle roaded section. That section is supplemented with triploid hatchery catchable trout, though WRBT densities have remained consistent in that section over time.

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INTRODUCTION

Similar to many of the streams and rivers in the Idaho Batholith, the NFBR is a relatively unproductive river with low levels of dissolved solids and nutrients, and a low conductivity. Historically, the drainages within the Idaho Batholith received marine-derived nutrients from the carcasses of returning anadromous fishes. However, anadromous returns to the Boise River basin were extirpated after the construction of numerous dams in the system starting as early as the completion of the Boise River Diversion Dam in 1909. The basin consists of granitic rocks and sand that result in shallow soil that is prone to high rates of erosion. Erosion is further amplified following wildfires and large portions of the basin were burned in the Rabbit Creek Fire in 1994 and the McNutt Fire in 2009. Due to the low productivity and resulting low fish densities, coupled with low dissolved solids and low conductivity, snorkel surveys are the most effective sampling tool currently available for IDFG regional fisheries staff to implement on streams such as the NFBR.

Fifteen sites on the NFBR have been intermittently surveyed using snorkeling techniques since the late 1980s, with the most recent prior surveys being conducted in 2004. Following snorkel surveys in 2017, a strong correlation was observed between fish densities and the average flow across the three years prior to sampling. This finding corresponded with the findings of Copeland and Meyer (2011) who showed that stream flow three and four years previous to sampling, was the most important bioclimatic condition influencing Brook Trout *Salvelinus fontinalis* and Bull Trout *Salvelinus confluentus* densities in Idaho rivers. Given this apparent strong correlation between fish densities and flow patterns and knowing that 2017 was a record flow year, we decided to sample the NFBR for three consecutive years and compare observed densities across a short time period with varying flow conditions to see how much year to year variability in fish densities we might observe.

STUDY AREA

The North Fork of the Boise River (NFBR) originates on the west side of the Sawtooth Mountain Range and flows in a southwesterly direction for approximately 80 km before joining the Middle Fork Boise River (MFBR). Ridgeline elevations at the head of the drainage are around 2,500 m, while the elevation at the confluence with the MFBR is approximately 1,060 m. The NFBR loses approximately 960 m in elevation over the 75 km from where it becomes a third-order stream to its mouth, dropping an average of 12.8 m per kilometer over that distance.

Native game fish in the NFBR consist of wild Rainbow/Redband Trout (WRBT), Mountain Whitefish *Prosopium williamsoni* (MWF) and Bull Trout (BLT). Additionally, the roaded section of the river is annually stocked with 10,000 catchable-sized triploid hatchery Rainbow Trout from June through August. Recreation along the NFBR is variable due to topography and access. The lower 15 km are in a steep, narrow, non-trailed canyon section. This section is moderately popular among floaters in the spring, but experiences little angling effort most of the year. The middle section (river kilometers 15 - 45) is roaded with numerous camping areas and one developed campground. This section of river receives the highest amount of recreation and angling effort. The upper 35 km are also remote consisting of a trailed canyon section immediately above the roaded section. The upper most portion of the basin is accessible via a primitive and long forest road (this road was washed out in the spring of 2017 and remained impassable until it was reopened in the fall of 2018) or by flying into a remote airstrip at the U.S. Forrest Service's Graham Guard Station. As a result, the upper portion of the basin is also only moderately used for recreation.

METHODS

During summers 2017 to 2019, fifteen historic trend sites of various lengths were surveyed using entire-width snorkeling. We identified sites from previous sampling documentation that included written descriptions, drawings, photos, and GPS coordinates. This allowed for reasonably precise relocation of sites. Prior to our 2017 sampling, all fifteen sites had never been sampled in the same calendar year. Three of the 15 sites were sampled in the late 1980s, 10 of 15 in the late 1990s, and 13 of 15 in the early 2000s. All 15 sites were sampled from 2003 to 2004, which was the most recent sampling prior to 2017 (Table 23).

Sites were sampled with three snorkelers completing an entire-width snorkel survey. Methods for conducting fish abundance surveys by snorkeling followed the methods outlined by Apperson et al. (2015). Most sites (12 of 15) were sampled starting at the bottom of the site and working in tandem upstream. However, three sites consisted of deep pools that were sampled by floating downstream (Table 24). Snorkelers counted all fish within their respective lanes and estimated lengths to the nearest inch. Species, counts, and visually-estimated length were recorded on PVC wrist cuffs by each snorkeler during the survey, then transcribed to a datasheet immediately after the completion of each survey. Also following the completion of each snorkel survey, staff measured and recorded individual site length, as well as quartile widths using a handheld laser rangefinder (Leupold RX-1000). All snorkelers conducting surveys from 2017 to 2019 had previously attended the Department's snorkel training course.

The NFBR was stratified into three sampling sections (lower, middle, and upper) as in previous years. The lower section consists of six sites, the middle section five sites, and the upper section consists of four sites (Figure 57). Trends in relative abundance were compared by calculating species-specific density estimates for each site and comparing amongst years and river sections. Density was calculated as the count of each sportfish species divided by site area (site length multiplied by average width). Density was then corrected to fish per 100 m^2 to account for differences in area. Mean density for a particular site/year was calculated by dividing individual site fish observations by area first, then averaging densities, rather than by total fish observations across all sites and area and dividing.

RESULTS

WRBT were distributed throughout the drainage and were observed in all sampling sites during the study period from 2017-2019. In 2019, 352 WRBT were observed and site-specific densities ranged from 0.21 to 5.79 fish/100 m^2. In 2018, 249 WRBT were observed and site-specific densities ranged from 0 to 4.05 fish/100 m^2 (Table 24). In 2017, 136 WRBT were observed and site-specific densities ranged from 0 to 3.68 fish/100 m^2. WRBT densities increased in all three sample sections from 2017-2019 (Figure 58). Of the 352 WRBT observed in 2019, most (71%) were 250 mm or smaller, while 29% fish observed were larger than 250 mm. The largest individual WRBT observed was 508 mm while the smallest was 63 mm (Figure 59). Overall mean WRBT densities from 2017 - 2019 continued to increase from the previous sampling period (2003-2004) from 0.93 fish/100 m^2 to 1.55 fish/100 m^2 (Figure 60). When evaluated across all 15 sites, the overall 2017 - 2019 WRBT densities were lower than the overall densities in 2000-2001 (2.72 fish/100 m^2), but higher than the overall densities observed in the late 1980s (Figure 58). Mean 2019 WRBT density across all sites was 2.04 fish/100 m^2 while overall densities in the lower, middle and upper sections were 3.02, 1.21, and 1.89 fish/100 m^2, respectively (Table 25). Observed WRBT densities across the entire study reach and reach-specific densities were low in 2017 and increased throughout the study period.

MWF are widely distributed in the NFBR and during the study period 2017 – 2019, were found at least once at each of the sites. In 2019 alone, MWF were present in fourteen of the fifteen sites surveyed. A total of 165 MWF were observed in 2019 compared to 209 in 2018 and 115 in 2017 and site-specific densities ranged from 0 to 3.75 fish/100 m^2 (Table 24). Mean MWF density across all sites was 0.86 fish/100 m^2 while overall densities in the lower, middle and upper sections were 1.11, 0.61, and 0.81 fish/100 m^2, respectively (Table 25). During the 2017-2019 study period, observed MWF densities varied across years, however observed densities were lower than densities observed during 2000 - 2004. (Figure 60). MWF total length ranged from 89 to 470 mm, and the majority (76%) were 250 mm or greater (Figure 61).

Additional fishes were observed infrequently during the 2017-2019 study period. BLT were not observed in 2017 or 2019, however five were observed during the 2018 surveys (Table 24). Westslope Cutthroat Trout *Oncorhynchus clarki lewisi* (WSC) densities decreased during the study period from 0.14 fish/100 m^2 in 2017 to 0 fish/100 m^2 in 2019. (Table 25). A single Smallmouth Bass *Micropterus dolomieu* was observed in the lower canyon section in 2017 (the first ever observed in the NFBR), none were observed in subsequent years. Several native non-game fish species were also observed including sculpins *Cottus sp.*, Northern Pikeminnow *Ptychocheilus oregonensis* (NPM), and suckers *Catostomus sp.* With the exception of initial surveying efforts in the late 1980's, both NPM and sucker densities remained substantially lower than previous survey periods (Table 25). Hatchery Rainbow Trout were observed in the middle section in 2019 as surveys were conducted shortly after hatchery stocking in that section. Due to the high variability in hatchery trout presence correlated with stocking and snorkel survey timing, there is little value in looking at trends in hatchery trout densities over time.

WRBT relative density increased with increased stream flow at the entire stream level (Figure 62) and at the reach-specific level (Figure 63). This relationship between fish density and streamflow was the strongest for WRBT (R^2 = 0. 979) compared to other NFBR species. MWF relative density decreased with increased stream flow at the entire stream level (Figure 62).Patterns in MWF densities varied at the reach-level (Figure 65). NFBR MWF had the lowest correlation with three-year prior average stream flow and density (R^2 = 0.492).

DISCUSSION

Observed fish densities were low during initial sampling (1988 - 1989) and increased to a peak during the 2000-2001 sampling period. All prominent species had the highest observed densities in the 2000-2001 sampling period. During the most recent sample period (2017 – 2019), observed densities started low (similar to levels observed in the late 1980s) but increased throughout the sample period. The variation in species-specific fish density over time was most pronounced for the upper section of the NFBR while the middle and lower river sections had shown a much lower level of variation. With the exception of 1996-1997 and 2000-2001 when upper section WRBT densities were 5.59 and 5.05 fish/100 m^2, respectively, all other densities across sample years and sections have only ranged from 0.14 – 1.95 fish/100 m^2 (Table 24; Cassinelli et al. 2018). While analyzing data from the 2017 surveys, we discovered cumulative average streamflow for three years prior to the survey is correlated with fish densities. As noted earlier, these relationships are similar to those observed by Copeland and Meyer (2011). Outside of this study, there is little literature that evaluates seasonal variation in flow and densities of resident salmonid populations in a natural flowing river.

Copeland & Meyer (2011) compared relationships between annual streamflow for three years prior to the survey, while we compared the cumulative average of the three years prior to the survey. We recognize this is not a direct comparison of results, but in an unregulated and somewhat variable system such as the NFBR, the comparisons will suffice. Curiously, WRBT total length increased with relative fish density. Vincenzi et al. (2007) found body length decreased with density in salmonids across a range of age classes in Slovenia. If the NFBR, the WRBT population was at carrying capacity, we would expect a negative density dependent relationship between fish length and density, however we observed the opposite trend, suggesting that the NFBR WRBT population is not yet reached carrying capacity. The strong correlation observed between WRBT Trout densities in the NFBR and flow in the lower MFBR likely indicates that a combination of recruitment and fish movement are strongly correlated with streamflow.

Cassinelli et al. (2018) hypothesized that perhaps the schooling behavior of MWF and the spatial distribution of our snorkel sites biased our estimates of fish density. Many of our sites were in large pools or at the mouth of tributaries, and we potentially observed higher densities in these locations when flows were lower. Curiously, MWF total length decreased with relative fish density. While purely speculative, this may suggest that the NFBR MWF population is nearing capacity. However, this trend may also be related to the schooling nature of MWF, which may result in large shifts in observed fish density over time.

Bull Trout observations remain low and as we have noted in the past, this may be attributed to timing of the snorkel surveys and migration patterns. Most of the BLT that inhabit the NFBR are adfluvial and migrate into the river from Arrowrock Reservoir. Previous radio tracking of these fish found that by August, most of these fish have reached the peak distance of their migrations and are spawning in the numerous tributaries of the NFBR (Flatter 2000). Additionally, the presence of the two prominent non-game species in the NFBR (NPM and suckers) are likely strongly influenced by Arrowrock Reservoir. Arrowrock Reservoir is 11 miles downriver from the confluence of the NFBR and MFBR and supports large populations of both species (IDFG, unpublished data).

In the NFBR, snorkeling remains the most effective means of estimating fish densities. However, snorkel estimates can be biased by variation in observers, visibility, and flow. As a means to help limit this bias, snorkelers attended IDFG's snorkel training and sites were sampled at low flows during favorable weather conditions. Additional bias with historical sampling can occur due to variations in site locations. While historic descriptions, photos, and GPS coordinates helped limit this, exact site replication is difficult due to variation in landmarks and river features between sample years. Additionally, sites themselves can change within reaches. This is especially true when sites occur at the mouths of tributaries, as do many of the sites on the NFBR.

The NFBR remains a relatively remote watershed with limited access and disturbance. The most noteworthy disturbance events to occur in the basin were large wildfires. However, these fires occurred in 1994 and 2009 and there is little evidence that either event had a strong influence on the trends observed in fish densities throughout the basin during the sample period. Due to the limited accessibility and generally low densities of WRBT, especially of quality size, the upper and lower sections of the NFBR likely see limited fishing effort. The majority of the angling effort occurs in the middle roaded section. That section is stocked with 10,000 triploid hatchery catchable trout annually and WRBT densities have remained consistent in that section over time. Continued hatchery stocking in this section to supplement relatively low numbers of wild fish will continue to provide a fishery in this popular recreational section of river. Because the NFBR remains mostly unaltered and receives little fishing pressure, the most variable factor affecting the river and subsequent fish populations is annual streamflow. While there is not a streamflow gauge on the NFBR, there is a gauge on the MFBR below the confluence of the NFBR and the MFBR near Twin Springs, Idaho. Both rivers drain from parallel, similar aspect basins, and flow contributions from each river are highly correlated. Streamflow patterns at this gauge are influenced by both rivers, and the Twin Springs gauge is a suitable surrogate for flow patterns in the NFBR. The historic streamflow records for the MFBR gauge date back to 1911.

Based on findings from this study and the relationship between stream discharge and observed Salmonid density, our infrequent (once per decade) snorkel sampling of Idaho batholith rivers (i.e. NFBR, MFBR, and South Fork Payette River) may not be sufficient for trend monitoring. As documented in this study, observed densities may simply be a product of the flow regime in the years leading up to sampling. We suggest an intensive, multi-year sampling approach might be more appropriate. A preliminary comparison of WRBT densities in the MFBR compared to average flow three years prior to sampling also showed a strong correlation. However, the MFBR has only been sampled three times with the last sampling occurring in 2000.

RECOMMENDATIONS

Based on results from our three year sampling cycle on the NFBR, short term (< 5 years) intensive (annual) snorkel surveys can be related to stream discharge patterns to predict trends in relative fish densities in Idaho batholith streams. Now that the survey cycle is complete on the NFBR, IDFG Region 3 fisheries staff will begin a three-year snorkel survey on the MFBR and relate it to streamflow.

Table 22. All snorkel trend sites sample areas (m^2), by river section, sample site, sample direction (upstream; US or downstream; DS) and sample year for the North Fork Boise River.

River section	Sample site	Sample direction	Sample year										
			1988	1989	1996	1997	2000	2001	2003	2004	2017	2018	2019
Upper	Silver Creek	US	-	-	-	-	546	-	-	486	560	630	650
	Graham Bridge	US	-	-	-	-	549.9	-	-	597	405	410	525
	Bluejay Creek	US	-	-	521	946	688.5	-	-	710	1036	1414	1400
	Horsefly Creek	US	-	358.2	358.2	982	937.2	-	-	969	708	780	990
Middle	Deer Park	US	-	-	264	-	243.6	-	363.1	-	897	962	1234
	Bear River	US	-	-	1390	-	1178	-	1266	-	1297	1345	1628
	Crooked River	US	-	-	1086	-	1214	-	1071	-	1534	1534	1530
	Black Rock	DS	2826	2826	1778	-	-	-	1711	-	1837	1834	1995
	Rabbit Creek	US	3047	-	1293	-	1041	-	1317	-	1430	1425	1313
Lower	Short Creek	US	-	-	1215	-	-	971.2	1246	-	1302	1102	1458
	X1	DS	-	-	-	-	-	1009	835.5	-	1089	1001	880
	01 Sucker Hole	US	-	-	-	-	-	453.8	753.9	-	1110	1058	1219
	X2	US	-	-	-	-	-	1055	1123	-	1099	1067	1134
	French Creek	US	-	-	338	-	-	768.1	997.9	-	503.2	444.3	511.5
	96 Sucker Hole	DS	-	-	722	-	-	-	676.5	-	1004	1020	1100

Table 23. Fish densities (fish/100 m^2) by river section, sample site and species observed during the 2019 North Fork Boise River snorkel surveys.

		Fish density (fish/100 m^2)		
River section	Sample site	HRBT	MWF	WRBT
Upper	Silver Creek	0	0	2.15
	Graham Bridge	0	1.9	3.05
	Bluejay Creek	0	0.71	0.21
	Horsefly Creek	0	0.61	0.61
Middle	Deer Park	0.65	0.08	2.27
	Bear River	0	1.41	0.18
	Crooked River	0	0.26	0.33
	Black Rock	2.01	0.25	1.3
	Rabbit Creek	1.6	1.3	0.84
Lower	Short Creek	0	0.82	2.47
	X1	0.34	3.75	5.34
	01 Sucker Hole	0	0.33	1.39
	X2	0	0.35	2.56
	French Creek	0	0.98	5.08
	96 Sucker Hole	0	0.55	0.82

Table 24. Fish densities (fish/100 m^2) by species for each river section across all sampling years of the North Fork Boise River.

Section	Year	WRBT	BLT	WSC	MWF	HRBT	NPM	Sucker
Upper	1989	0.84	0.31	0.36	1.29	0.42	0.48	1.74
	1996	7.86	0.45	0.14	0.84	0.81	0.14	0
	1997	3.31	0.21	0.16	0.05	0	0.05	0
	2000	5.05	1.03	0.08	6.64	0.04	0	0
	2004	1.4	0.11	0.07	3.22	0	0	0
	2017	0.61	0	0.04	1.92	0	0	0
	2018	1.01	0.02	0	2.09	0	0	0
	2019	1.89	0	0	1.58	0	0	0
Middle	1988	0.09	0	0	0.29	0.06	0	0
	1989	0.18	0	0	0.28	0.88	0	0
	1996	0.95	0	0	1.21	2.43	0.69	1.32
	2000	1.17	0	0	4.08	0.58	0.64	2.49
	2003	0.68	0	0	2.1	0.39	0.11	0
	2017	0.96	0	0.34	0.29	0.22	0	0
	2018	1.13	0	0.05	0.93	0.44	0	0.07
	2019	1.21	0	0	0.61	1.82	0	0
Lower	1996	0.19	0	0	1.19	0.14	1.12	3.36
	2001	1.95	0	0	1.63	0	0.37	3.6
	2003	0.71	0.02	0.02	1.55	0	0.07	0.15
	2017	1.31	0	0.05	0.27	0	0.02	0.02
	2018	2.81	0.15	0.03	1.26	0	0.06	0
	2019	2.04	0	0			0	0
All Sites	198-1989	0.49	0	0	0.79	0.25	0	0
	1996-1997	2.24	0.07	0.03	0.95	1.21	0.63	1.52
	2000-2001	2.72	0.34	0.03	4.12	0.21	0.34	2.03
	2003-2004	0.93	0.04	0.02	2.29	0.13	0.07	0.06
	2017	0.96	0	0.14	0.83	0.07	0.01	0.01
	2018	1.65	0.06	0.03	1.43	0.15	0.03	0.02
	2019	2.04	0	0	1.1	0.34	0	0

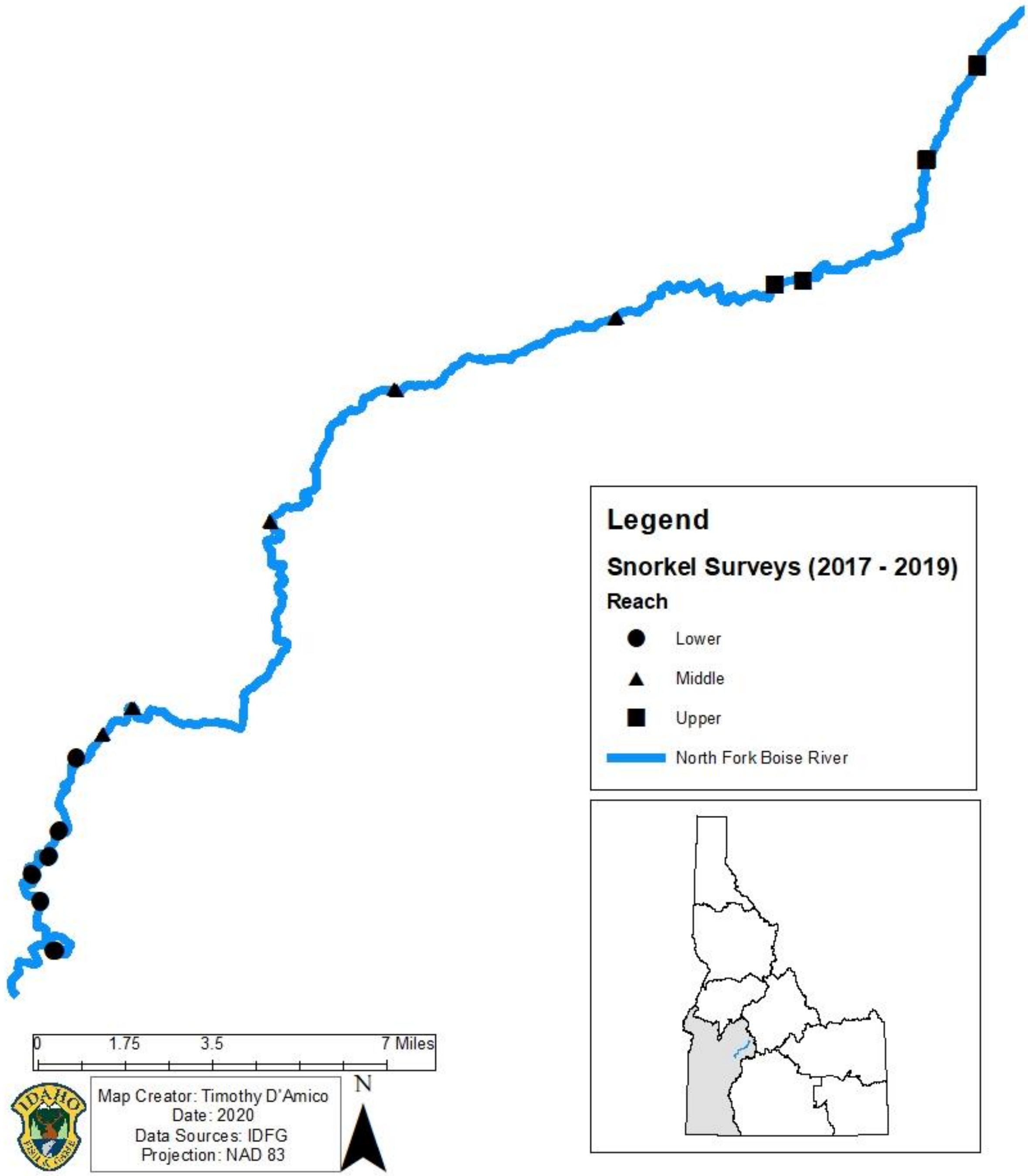

Figure 61. Locations of snorkeling sites sampled in the lower section of the North Fork Boise River during 2017 - 2019.

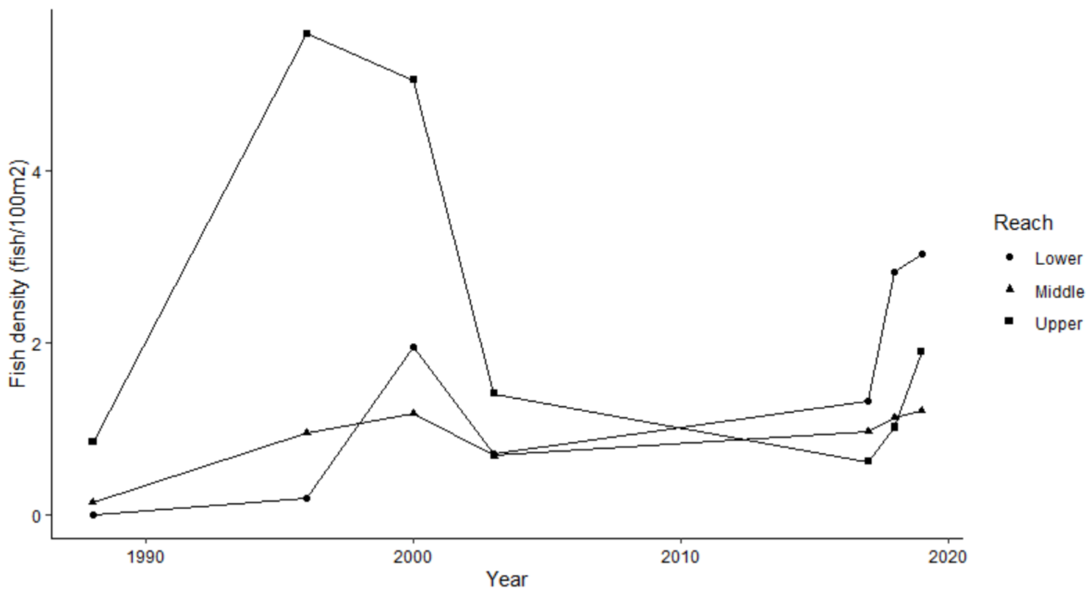

Figure 62. Mean observed fish densities (fish/100m^2) of WRBT in the upper, middle, and lower sections of the North Fork Boise River among sample years.

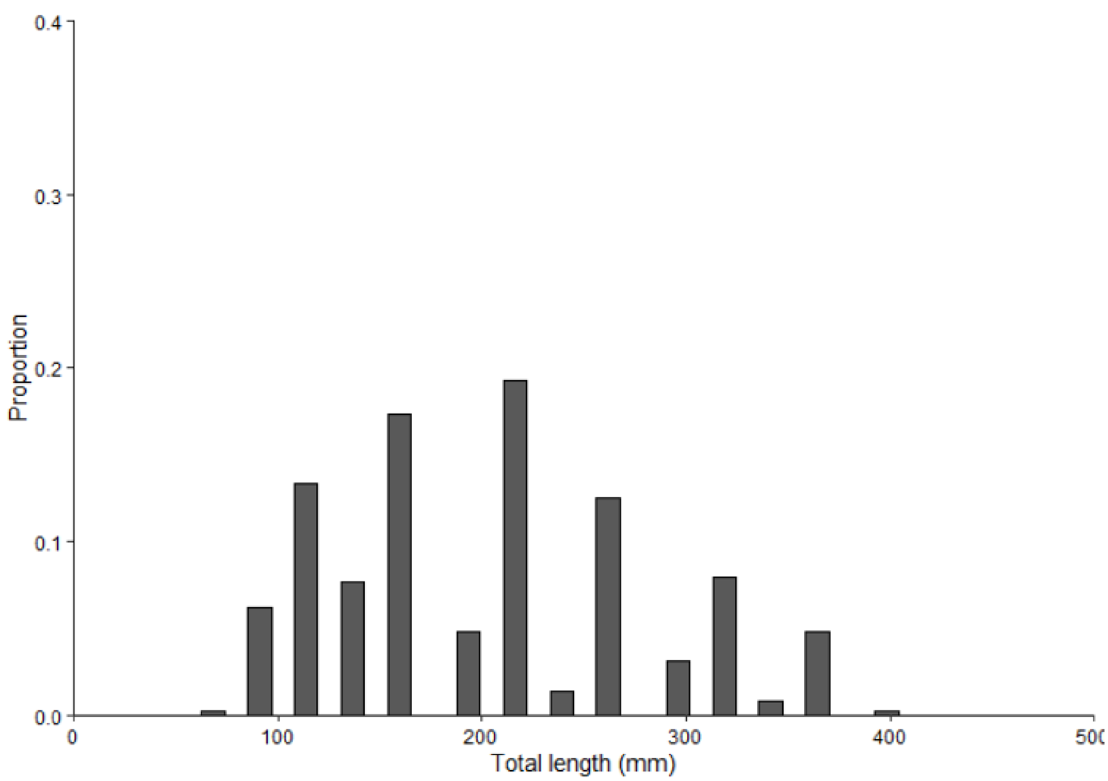

Figure 63. Proportional length-frequency distribution of WRBT observed in the North Fork Boise River during 2019.

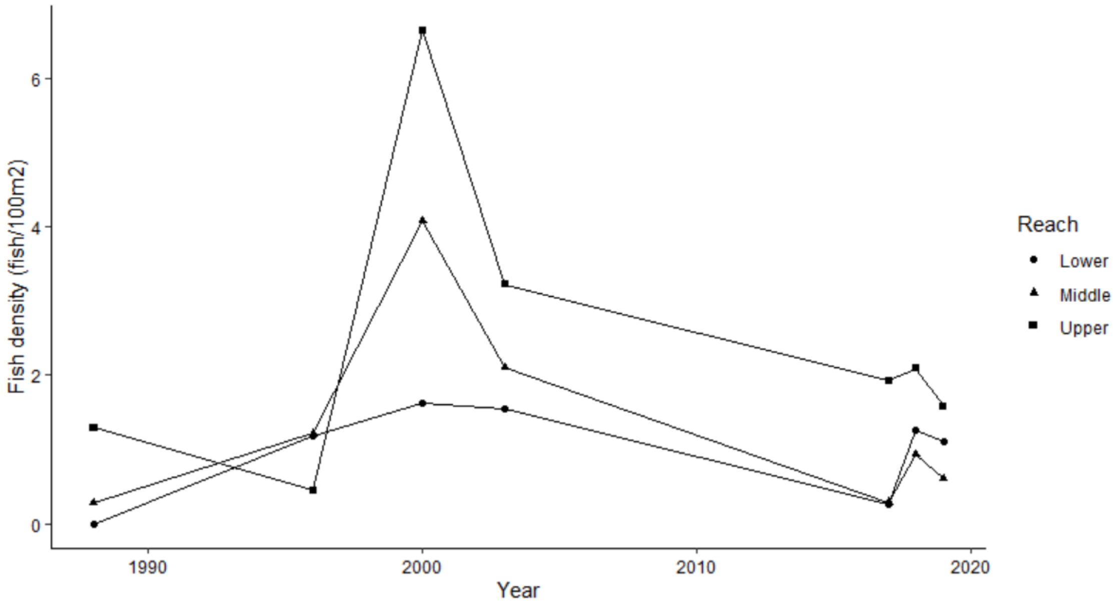

Figure 64. Mean observed fish densities (fish/100m^2) of MWF in the upper, middle, and lower sections of the North Fork Boise River among sample years.

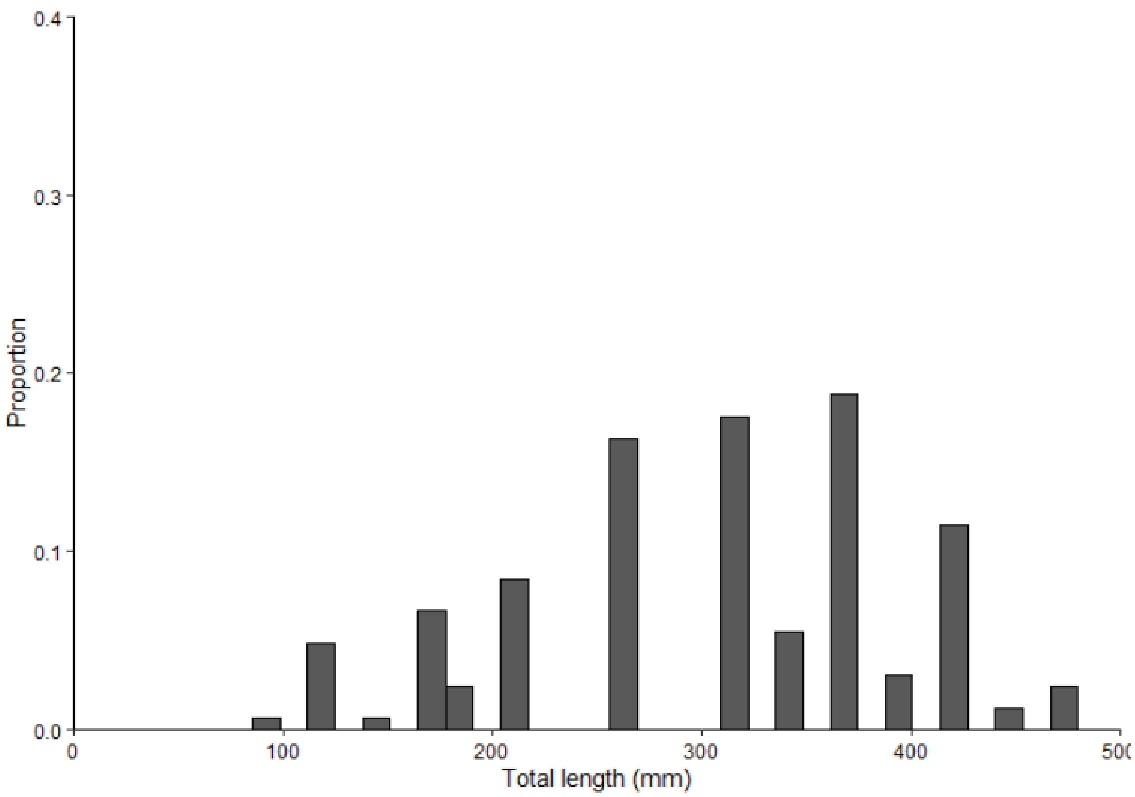

Figure 65. Proportional length-frequency distribution of MWF (n = 165) observed in the North Fork Boise River during 2019.

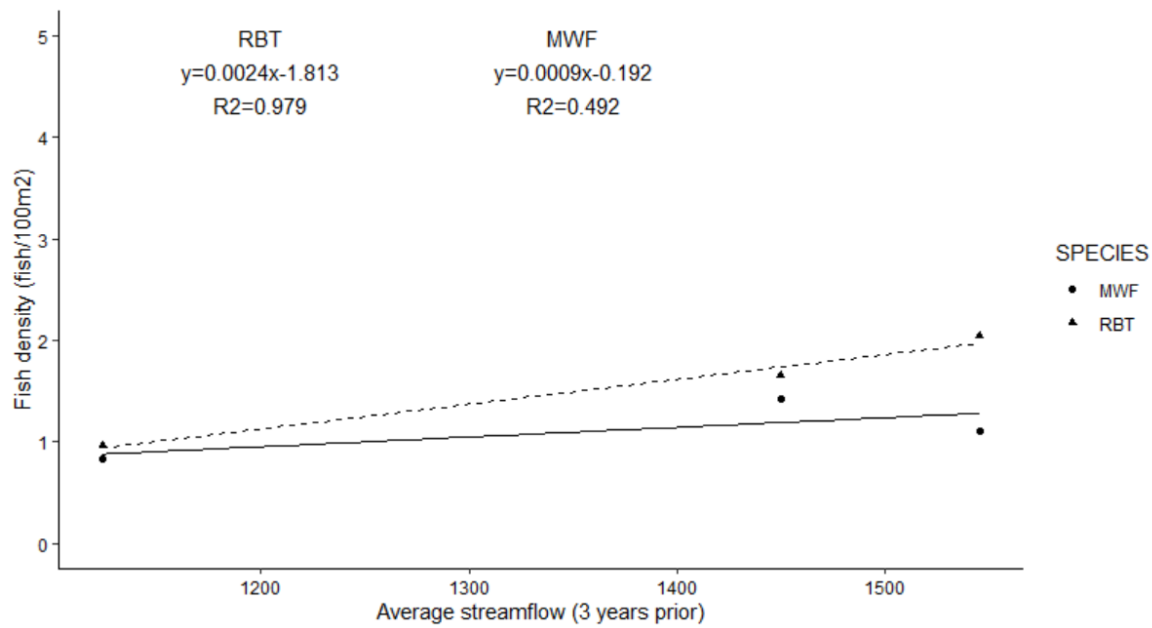

Figure 66. Observed mean fish densities (fish/100m^2) for RBT and MWF during the 2017 – 2019 North Fork Boise River snorkel surveys versus mean annual stream flow (cfs) for the three years preceding sampling. Flow measurements were recorded at the Middle Fork Boise River Twin Springs flow gauge (USGS gauge #13185000).

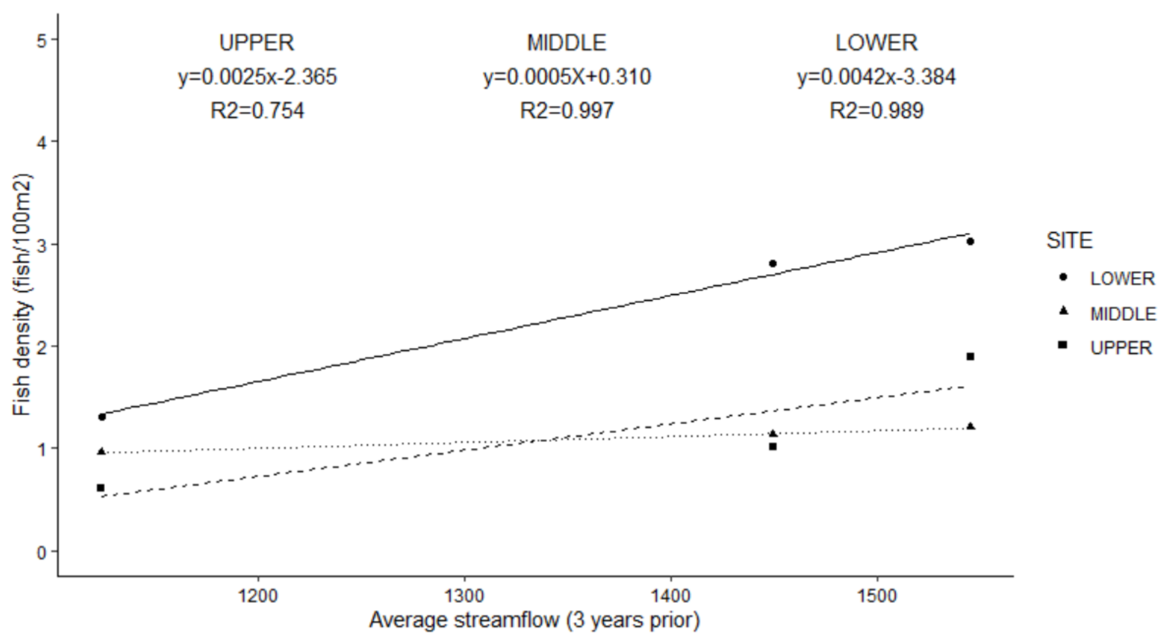

Figure 67. Mean observed WRBT densities (fish/100m^2) for the 2017 – 2019 sampling periods on the North Fork Boise River by stream reach versus average stream flow for the three years preceding sampling. Flow measurements were recorded at the Middle Fork Boise River, Twin Springs flow gauge (USGS gauge #13185000).

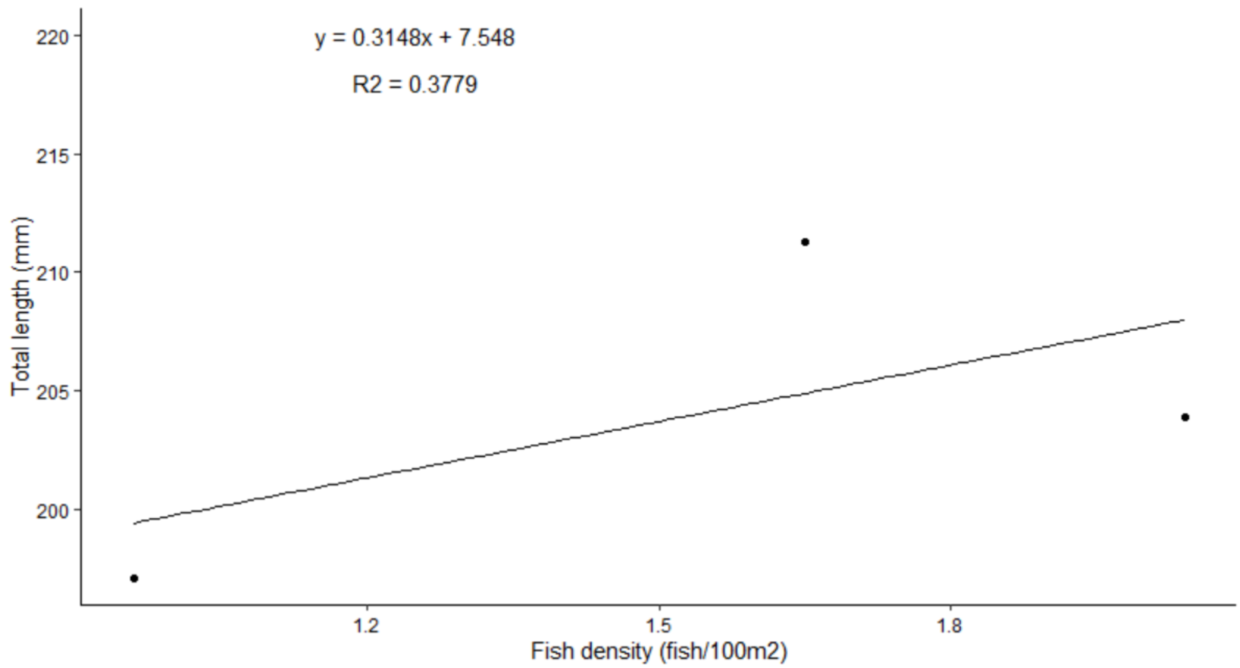

Figure 68. Observed mean WRBT total length (mm) vs fish density (fish/100 m^2) for the 2017 – 2019 sampling periods on the North Fork Boise River.

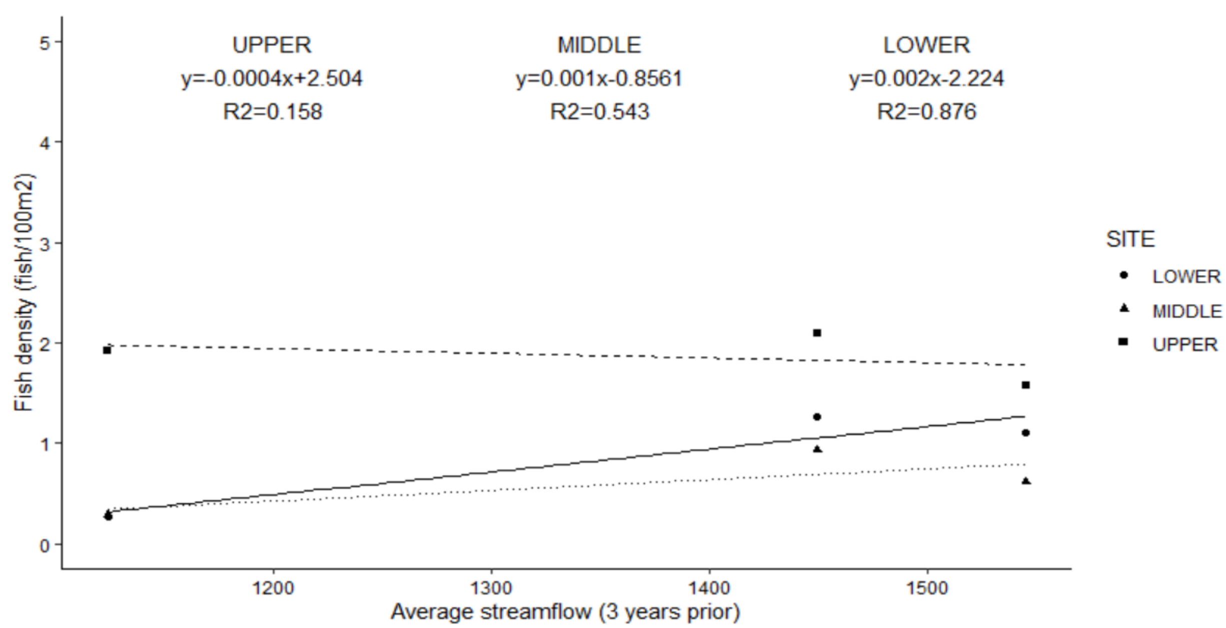

Figure 69. Observed mean MWF densities (fish/100m^2) for the 2017 – 2019 sampling periods on the North Fork Boise River by stream reach versus average stream flow for the three years preceding sampling. Flows are from the neighboring Middle Fork Boise River Twin Springs flow gauge (USGS gauge #13185000).

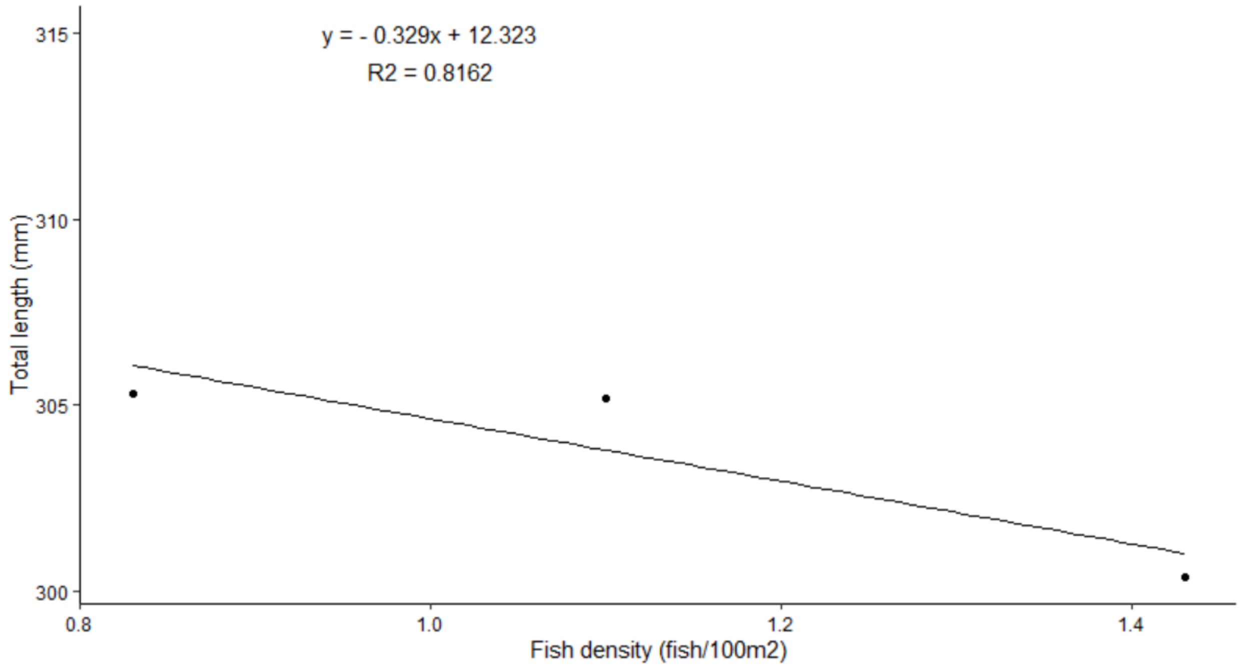

Figure 70. MWF total length (mm) vs fish density (fish/100m^2) for the 2017 – 2019 sampling periods on the North Fork Boise River.

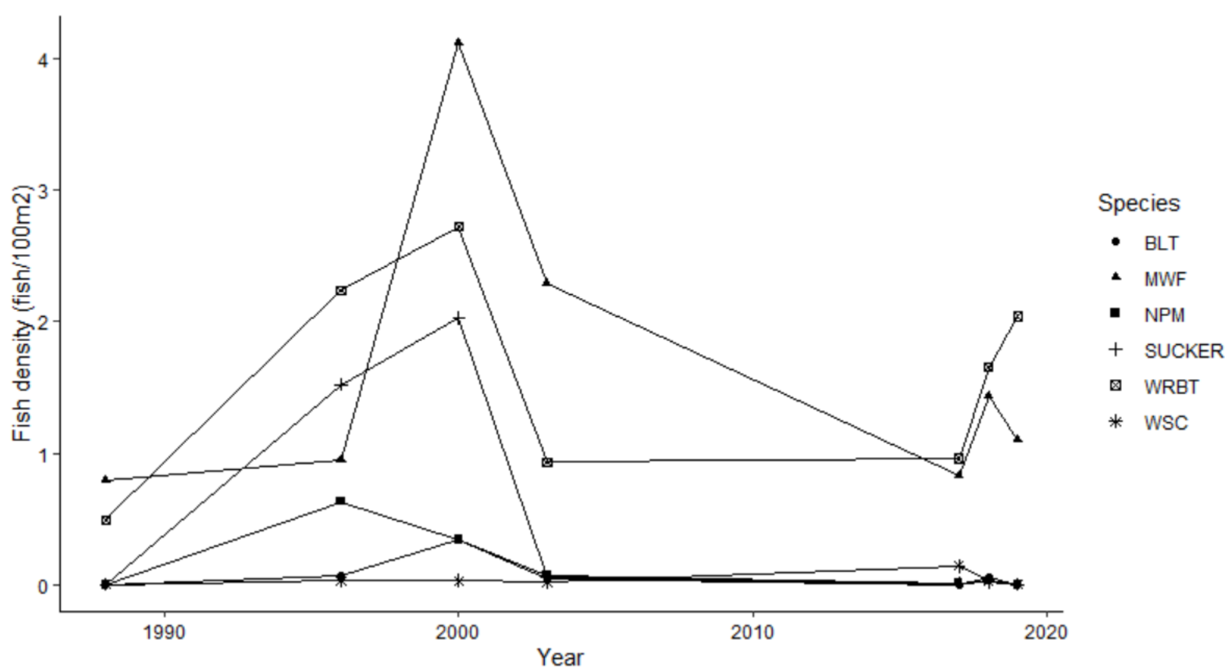

Figure 71. Fish density (fish/100 m^2) of all prominent fish species observed across all sample years in the North Fork Boise River.

LONG-TERM MONITORING OF REDBAND TROUT POPULATIONS IN THE OWYHEE RIVER DRAINANGE

ABSTRACT

In 2019, the Idaho Department of Fish and Game (IDFG) continued population and trend monitoring for interior Redband Trout (*Oncorhynchus mykiss gairdneri*) within the Idaho portion of their range. Two tributaries, Jordan and Louse Creek, were sampled in 2019. Louse Creek is a tributary to Jordan Creek and both creeks are within the Jordan Creek HUC4 watershed which ultimately drains into the Owyhee River. Using a systematic sampling design, 17 sites were selected on Jordan Creek and 8 selected on Louse Creek. Fifteen sites were successfully sampled on Jordan Creek with Redbands present in nine. Three sites were sampled on Louse Creek with Redbands found in in all three sites. Density estimates for Jordan Creek ranged from 0 to 30.94 fish per 100 m^2 with those of Louse Creek ranging from 3.13 to 7.18 fish per 100 m^2. The data collected from Louse Creek will serve as baseline data moving forward since this is the first time IDFG has sampled the drainage. The data from Jordan Creek appears similar to previous surveys conducted in 2008 and 2003 and this population appears stable.

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INTRODUCTION

Redband Trout *Oncorhynchus mykiss gairdneri* are native to all major river drainages of Southwestern Idaho, including the Snake, Boise, Bruneau and Owyhee basins. Within this large and diverse geographic area, Redband Trout have adapted to a variety of stream habitats from montane to desert conditions. Some controversy has existed regarding whether adaptations to these disparate habitats has led to speciation at some level. In 1997, Redband Trout that reside in desert locales were petitioned for listing under the Endangered Species Act (ESA; USFWS 2000) under the assumption that they could be considered a separate subspecies, this petition was denied. Since that time, additional research has indicated that only one species of resident stream dwelling Redband Trout may exist in Southwest Idaho (Cassinelli 2008). Since 1997, considerable effort has been placed on determining the current species distribution and developing conservation strategies to ensure persistence.

Population status of the Redband Trout from montane habitats has been extensively studied in Southwestern Idaho. However, due to remoteness and little angling interest Redband Trout from desert habitats within the headwaters of the Bruneau, Owyhee and Snake basins have received less attention (Schill et al. 2007). As these populations are near the southern extent of the species' range and with water temperatures projected to increase, it is important to monitor the status of these fringe populations (Narum et al. 2010). Historic data includes a comparative assessment of Redband Trout distribution, density and size structure at 43 sites within these desert drainages from 1993-2003, data was collected at the same sites during 1997-1982 (Zoellick et al. 2005). In 2012, a range wide assessment was completed that included desert habitats. This study relied heavily on the available data and expert opinions to identify the current distribution of Redband Trout (Muhlfield et al. 2015). The assessment identified a framework to develop range-wide conservation measured and to provide structure for long-term species persistence, which was developed in 2016 (IRTC 2016). Specifically within the Conservation Strategy, the Idaho Department of Fish and Game (IDFG) agreed to continue population and trend monitoring within Redband Trout distribution. This monitoring effort continued in 2019 with Redband Trout surveys conducted in two tributaries within the Jordan Creek watershed located in the Owyhee Mountains of Southwest Idaho.

METHODS

In 2019, Jordan and Louse Creeks were selected as the target drainages. Both of these creeks are found in the Jordan Creek HUC4 watershed. Individual sample sites were determined following the systematic sampling design described in Peterson et al. (2018), which allowed for approximately five percent of the total stream length to be sampled. On Jordan Creek, 33 sites were identified and eight sites were identified on Louse Creek. Due to time constraints, Jordan Creek's sites were halved to 17 sites for the 2019 field season. Land ownership for each site was determined using Owyhee County GIS layers and access was obtained for as many sites as possible. Jordan Creek sites 5 and 6 are located on public land but there is no access into the canyon except through private property and access was not obtained. Private property access was procured for Louse Creek but due to time constraints and the remote nature of the upper five sites, these were not able to be sampled in the 2019 field season.

Using multiple-pass depletion methods, Redband Trout abundance in Jordan and Louse Creeks were estimated at the 18 sampled sites (Figure 69). Fish were collected over 100m of stream distance with a Smith-Root LR-24 backpack electrofisher and a three person crew. The number of electrofishing passes conducted was determined by the catch rates of Redband Trout. If more than 5 individuals were captured on the first pass, a second pass was completed. If the second pass capture was more than 25% of the first pass's capture, a third pass was also completed. Redband Trout captured in each pass were held in separate buckets. Upon completion of the electrofishing, individual fish were measured for total length (mm). Fin clips were collected to determine if genetic introgression had occurred with non-native strains of Rainbow Trout. Non-game fish captured were identified to species and the number observed for each species was categorized as sparse (1-10), many (10-50) or abundant (>50).

Following fish surveys, the physical characteristics of the stream channel were also sampled within the 100m surveyed reach. Habitat measurements including wetted width and water depth were collected at 10 transects. Wetted width was measured in meters from the water margin perpendicular to the flow every 10 meters through the 100 meter site. Water depth was also measured at these 10 meter intervals and five depth measurements were taken across the wetted width and averaged for each transect. The wetted width measurements were used to determine surface area sampled, this value was then used to determine Redband Trout densities at each site.

Population estimates and 95% confidence intervals were calculated using the Carle-Strub method in R version 3.6.1 for the total catch at each site (Ogle 2016). Due to the potential for size-related catchability differences, population estimates were also calculated for two size classes of Redband Trout, small (< 100mm) and large (≥ to 100mm). If all sampled fish were collected in the first pass, maximum likelihood estimates could not be developed and capture efficiency was assumed to be 100%. Confidence intervals for population size (N) and mean density were calculated using α=0.05.

RESULTS

Total catch of Redband Trout in 2019 was 358 fish, which were captured across 9 of the 15 sampled sites on Jordan Creek and in all 3 sampled sites on Louse Creek (Table 26). This total catch was comprised of 274 (76.5%) large (≥ 100mm) total length and 84 (23.5%) small (< 100mm). Catch rates ranged from 0 to 99 trout per site. Population estimates were generally very similar to the total catch due to the high capture efficiency of our sample. The mean density of Redband Trout across all occupied sites was 8.09 trout per 100 m^2 (Table 2).

Length frequency histograms were also generated for the total Redband Trout catch at each of the streams sampled. Jordan Creek shows a distribution of mostly medium sized individuals with few very large or very small Redband Trout but the majority of size bins are represented (Figure 70). Conversely, the size distribution of Redband Trout in Louse Creek is very patchy, with numerous size bins absent from our sample (Figure 71).

Nongame fish observed across the 18 sampled sites include Chiselmouth *Acrocheilus alutaceus*, Redside Shiner *Richardsonius balteatus*, Northern Pikeminnow *Ptychocheilus oregonensis*, Speckled Dace *Rhinichthys osculus*, Longnose Dace *Rhinichthys cataractae*, Large Scale Sucker *Catostomus macrocheilus*, Bridgelip Sucker *Catostomus columbianus* and Sculpin Cottus spp.; likely Mottled or Shorthead Sculpins based on the species' ranges (Wallace and Zaroban 2013).

DISCUSSION

The populations of Redband Trout in Jordan Creek appear to be stable to increasing in the headwater and middle sections (headwater to Flint Creek confluence) since the last sampling event in 2008, although sampling did not occur within the same sites. The data collected from Louse Creek is important baseline information since this is the first time that this stream has been sampled by IDFG.

The incidence of Redband Trout increased as surveys advanced into the headwaters of the Jordan Creek drainage. Factors that may be influencing this observed distribution include temperature regime, competition with nongame fish in the lower reaches and habitat condition, among others (Meyer et al. 2014). Several diversion dam structures, both permanent and temporary, are found on Jordan Creek and may be impacting both habitat suitability and fish passage.

Redband Trout genetic samples were collected from both streams but results were not available at the time of this report.

Brook Trout were captured in Jordan Creek site JC15 at the Bureau of Land Management (BLM) campground in Silver City, ID. Brook Trout are known to be more aggressive than many western native fishes, including Redbands (Peterson and Fausch 2013). Based on IDFG data, this species has been present in this section of Jordan Creek since at least 2003. Future surveys will continue to monitor for the presence of non-natives as they may pose a threat to the native Redband populations.

RECOMMENDATIONS

1. Continue to monitor Redband Trout distribution and abundance within the Jordan Creek HUC4 using the systematic sampling design developed in 2016.

2. Continue to document the distribution and densities of non-native species within the Jordan Creek HUC4.

3. Identify a habitat improvement project that would benefit Redband Trout within the Jordan Creek basin.

4. Monitor the Brook Trout population in and around Silver City, ID (site JC15) to determine if additional management is warranted.

5. Deploy temperature loggers throughout the Jordan Creek HUC4 to document temperature trends.

Table 25. Summary of the sites sampled for Redband Trout within the Jordan Creek HUC4 in 2019.

Stream name	Sites selected	Sites sampled	# Sites where trout observed
Jordan Creek	17	15	9
Louse Creek	8	3	3

Table 26. Nongame fish catch described as categorical abundance across the 18 sites sampled in Jordan and Louse Creeks. Species abbreviations include CHM: Chiselmouth, RSS: Redside Shiner, NPM: Northern Pikeminnow, DAC: Dace spp., LND: Longnose Dace, LSS: Largescale Sucker, BLS: Bridgelip Sucker, SCL: Sculpin spp.

Site #	Stream Name	CHM	RSS	NPM	DAC	LND	LSS	BLS	SCL
JC 01	Jordan Creek	>50	>50	>50	>50	-	>50	-	-
JC 02	Jordan Creek	-	>50	>50	>50	-	>50	-	-
JC 03	Jordan Creek	-	-	10 - 50	>50	-	-	>50	-
JC 04	Jordan Creek	1 - 10	>50	10 - 50	-	-	>50	-	-
JC 07	Jordan Creek	-	>50	10 - 50	10 - 50	-	10 - 50	-	-
JC 08	Jordan Creek	-	-	-	>50	-	>50	-	-
JC 09	Jordan Creek	-	>50	-	>50	>50	>50	-	-
JC 10	Jordan Creek	-	>50	-	>50	-	-	-	-
JC 11	Jordan Creek	-	-	-	-	-	-	-	-
JC 12	Jordan Creek	-	-	-	1 - 10	-	-	-	-
JC 13	Jordan Creek	-	-	-	>50	-	>50	-	-
JC 14	Jordan Creek	-	-	-	-	-	-	-	-
JC 15	Jordan Creek	-	-	-	>50	-	1 - 10	-	-
JC 16	Jordan Creek	-	-	-	-	-	-	-	-
JC 17	Jordan Creek	-	-	-	-	-	-	-	-
LC 01	Louse Creek	-	-	-	-	-	-	-	-
LC 02	Louse Creek	-	>50	-	>50	-	>50	-	1 - 10
LC 03	Louse Creek	-	>50	-	>50	-	10 - 50	-	>50

Table 27. Site specific catch, abundance and density estimates of Redband Trout for all captured fish, those less than 100 mm and those greater or equal to 100 mm in total length for each site sampled in 2019. Lower confidence limits (LCL) and upper confidence limits (UCL) for population and density estimates were calculated with using α = 0.05.

Site #	Stream Name	Pass 1	Pass 2	Pass 3	Total	N	LCL	UCL	Capture Efficiency ((N/Pass 1)*100)	Density (N/100m^{2})	LCL	UCL
					ALL FISH							
JC 01	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 02	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 03	Jordan Creek	1	–	–	1	–	–	–	–	–	–	–
JC 04	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 07	Jordan Creek	2	–	–	2	–	–	–	–	–	–	–
JC 08	Jordan Creek	1	–	–	1	–	–	–	–	–	–	–
JC 09	Jordan Creek	30	4	–	34	34	33	35	88.2	7.18	6.97	7.39
JC 10	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 11	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 12	Jordan Creek	0	–	–	0	–	–	–	–	–	–	–
JC 13	Jordan Creek	21	3	–	24	24	23	25	87.5	5.17	4.96	5.39
JC 14	Jordan Creek	46	5	–	49	51	49	53	93.9	14.43	13.9	15
JC 15	Jordan Creek	90	9	–	99	99	97	101	90.9	30.94	30.3	31.6
JC 16	Jordan Creek	84	6	–	90	90	89	91	-	29.04	28.7	29.4
JC 17	Jordan Creek	18	–	–	18	–	–	–	–	–	–	–
LC 01	Louse Creek	2	–	–	2	–	–	–	–	–	–	–
LC 02	Louse Creek	18	6	1	25	25	24	26	-	7.18	6.89	7.46
LC 03	Louse Creek	9	2	–	11	11	10	12	-	3.13	2.84	3.41
					< 100 mm							
JC 09	Jordan Creek	6	–	–	6	–	–	–	–	–	–	–
JC 13	Jordan Creek	10	3	–	13	13	11	15	-	2.8	2.37	3.23
JC 14	Jordan Creek	28	5	–	33	33	31	35	-	9.34	8.77	9.91
JC 15	Jordan Creek	9	–	–	9	–	–	–	–	–	–	–
JC 16	Jordan Creek	10	3	–	13	13	11	15	-	4.19	3.55	4.84
JC 17	Jordan Creek	4		–	4	–	–	–	–	–	–	–
LC 02	Louse Creek	4	1	1	6	6	5	7	-	1.72	1.44	2.01
					≥ 100 mm							
JC 03	Jordan Creek	1	–	–	1	–	–	–		–	–	–
JC 07	Jordan Creek	2	–	–	2	–	–	–		–	–	–
JC 08	Jordan Creek	1	–	–	1	–	–	–		–	–	–
JC 09	Jordan Creek	24	4	–	28	28	26	30		5.91	5.49	6.33
JC 13	Jordan Creek	11	–	–	11	–	–	–		–	–	–
JC 14	Jordan Creek	18	–	–	18	–	–	–		–	–	–
JC 15	Jordan Creek	81	9	–	90	90	88	92		23.09	22.6	23.6
JC 16	Jordan Creek	74	3	–	77	77	76	78		24.85	24.5	25.2
JC 17	Jordan Creek	14	–	–	14	–	–	–		–	–	–
LC 01	Louse Creek	2	–	–	2	–	–	–		–	–	–
LC 02	Louse Creek	14	5	–	19	20	16	24		5.45	4.59	6.89
LC 03	Louse Creek	9	2	–	11	11	10	12		3.13	2.84	3.41

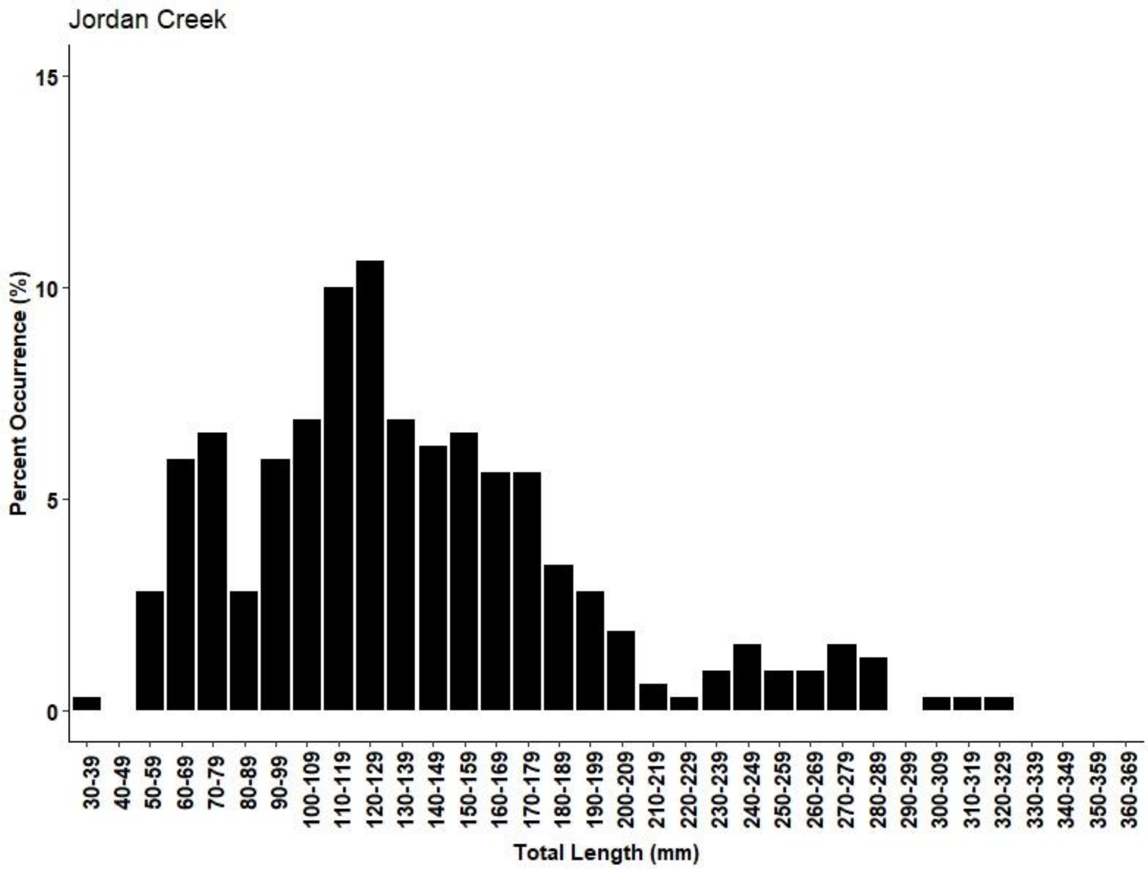

Figure 72. Length frequency distribution of all Redband Trout captured across all sampled sites of Jordan Creek in 2019.

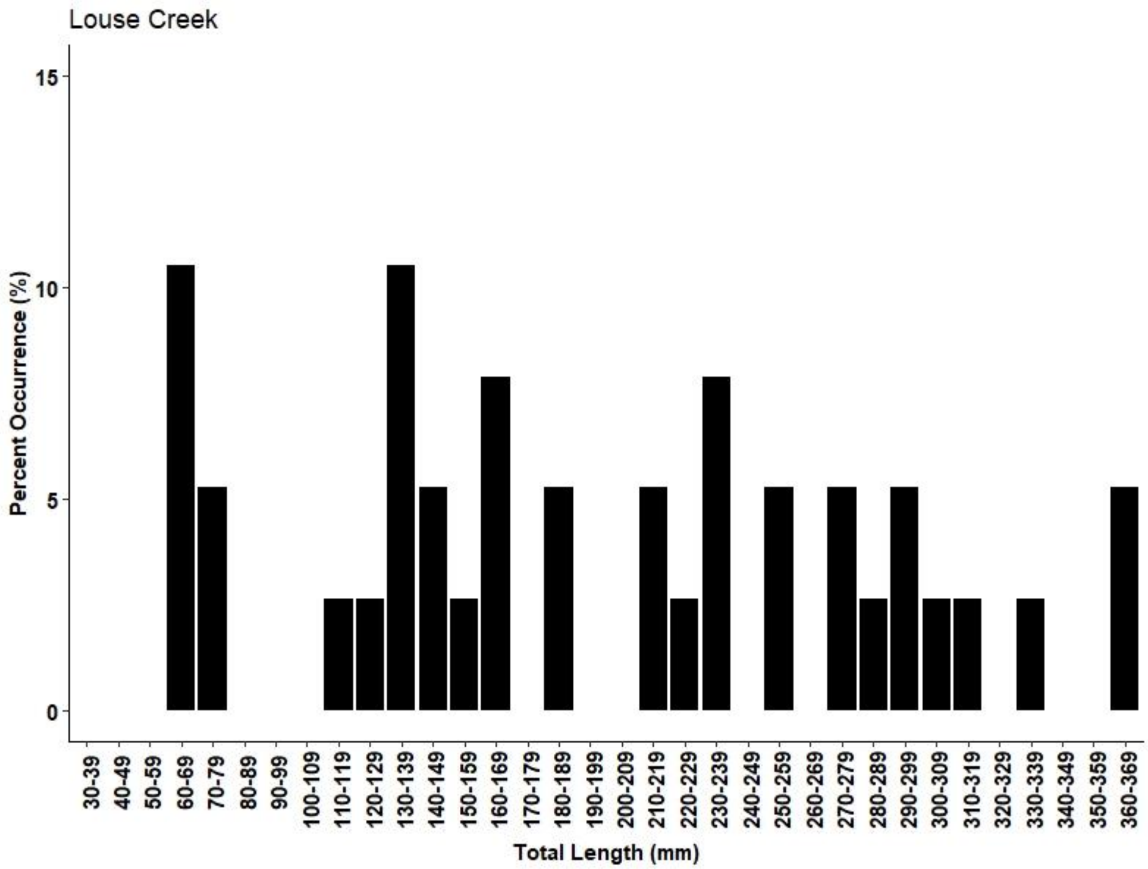

Figure 73. Length frequency distribution of all Redband Trout captured across all sampled sites of Louse Creek in 2019.

FISHING & BOATING ACCESS PROGRAM

SOUTHWEST REGION

ABSTRACT

Staff maintains 67 fishing and boating access sites and campgrounds within IDFG's Southwest Region. Sites need continual maintenance, repair, and cleaning. In 2019, these responsibilities were completed as usual. In addition, staff facilitated the initiation or completion of several improvement projects at IDFG-owned properties including Horsethief/Kings Point, Olds Ferry, Seven Mile Slough, Sheep Camp, Bernard Landing, Red Top Pond, Indian Creek, Horseshoe Bend Mill Pond, Sawyers Pond, Immigration and Martins Landing. Staff also completed five Wildlife Management Area (WMA) improvement projects including a Boise River WMA parking lot (archery course), Birding Island North Fence, Blacks Bridge house removal, Crane Falls Cattle guard rebuild, and CJ Strike WMA Parking lot expansion. Furthermore, staff initiated or completed two new access acquisitions including a new site near CJ strike on the Snake River and Sawyers Two (Dick Knox Pond). Currently our Caldwell Pond site is under closure until 2025 for gravel removal to deepen and widen the pond for increased fishing quality and opportunity. Staff spent considerable time developing or improving partnerships to cooperatively manage camping at Horsethief Reservoir with the YMCA and other partners, improve access to the lower Payette River with Gem County, and assisted with maintenance and management of camping at Martin Landing. Another effort made by staff this year, has been improving signage at sites. New this year, the access program developed a volunteer program to monitor access sites more regularly, report issues to access staff and help with light litter pickup. Working cooperatively with the Master Naturalist program we have been able to get a volunteer to adopt every access site in the region. This allows access staff to be able to focus on more pressing projects of the region and less on the smaller issues with sites.

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INTRODUCTION

The goal of Idaho Department of Fish and Game's Fishing and Boating Access program is to provide high-quality developed access sites and amenities that allow hunters, anglers, and trappers to safely utilize and enjoy a wide variety of water types throughout southwest Idaho. Staff maintains 67 fishing and boating access sites and campgrounds within IDFG's Region Three boundaries including the McCall sub-region. Within this large geographical area, a total of 25 developed access sites are located on properties owned by IDFG, while the remaining 42 developed access sites provide opportunities on and from non-department owned properties. Also, access to properties owned by others (state, federal, or non-governmental organizations) is provided with cooperative agreements, memorandums-of-understanding, or right-of-ways. Access facilities and properties require a high amount of maintenance. Maintenance activities and frequencies are adjusted to account for use, weather, vandalism, and other factors. Typical maintenance activities include: campground maintenance, cleaning and pumping vault toilets, addressing vandalism and dumped garbage materials, maintaining and repairing pumps and other water control structures, inspecting and maintaining dams, repairing boat ramps, grading roads and parking areas, asphalt maintenance, managing cleaning contractors, installation and maintenance of docks, removing sediment from boat ramps and pond inlet and outlet structures, managing vegetation, maintaining border fences, hazard tree removal as well as installing and replacing worn or damaged signs.

Additionally, staff assists with maintenance of facilities for Regional offices and takes on numerous cooperative WMA projects that range from cattle guard repair to parking lot expansion. With facilities maintenance, staff set up and oversee contracts and complete in-house repairs of buildings including plumbing, electrical, HVAC maintenance, monthly maintenance of fire systems, irrigation repair and a variety of other building fixes. Also, maintenance staff is responsible for a variety of equipment and machinery repairs including preventative maintenance.

In addition to normal maintenance responsibilities and activities, regional staff participates in capital improvement projects that often involve constructing amenities at new or existing sites and replacing worn infrastructure. Furthermore, staff encourages and facilitates the development of fishing and boating access sites and opportunities on properties owned by others such as city or county governments. Funding for this program originates from a variety of sources including the Dingell-Johnson and Pittman-Robertson excise taxes administered by the U.S. Fish and Wildlife Service; license money generated from the sales of IDFG licenses, tags, and permits; mitigation settlements; as well as through a variety of grant sources.

ACCOMPLISHMENTS

Staff completed typical operations and maintenance activities as expected. In addition, staff contributed directly to the completion of several larger-scale renovation or repair projects on department-managed properties during 2019. One project was the Sheep Camp boat ramp repair. Due to its location, turbulent waters undercut the base of the ramp and eroded its adjacent banks. Staff removed a section of the ramp and used a variety of substrates to rebuild the base and relay ramp blocks in order to better support the ramp from further erosion and total loss. Staff also made repairs to other ramps including Hwy 52 Access. This year we were able to attain an equipment upgrade to our backhoe which should allow us to do future repair work to boat ramps and clearing structures with its thumb attachment.

In the Emmett area, we had a new boat ramp installed at Seven Mile Slough and a piling installed at Sawyers Pond for a dock needing secured. At Duff Lane Pond near Star, ID we are working to replace a section of fence between the pond and its northern neighbor and clearing out a section of trees encroaching power lines. We also did an aquatic herbicide treatment of the pond and worked with our volunteer coordinators to elicit a volunteer to do trail clearing and tree removal around the pond. We also have been upgrading signage in both the Star and Emmett areas including a new Highway access sign for the Sheep Camp and Airport Middleton sites. Nearby, our Horseshoe Bend Mill Pond site had a motor that quit working on the pump that supplies water to the pond. It was recommended to have the pump rebuilt as it was 20 years old and has been struggling to pump water. Currently the pump has been rebuilt and is back in place to augment the pond at low flow times with Payette River.

At Wilson Ponds, staff had to pull and entirely rebuild the bearings and make repairs to two of our three roller screens at the access area. Also, we had to pull the pump which supplies water to the Beaches Pond and get it rebuilt and repaired. Currently we are working with the Gem State Fly Fishers to utilize a donation to better promote fishing activities in the area.

We completed numerous projects at our lower Snake River sites. At Bernard's Landing we worked with local landowners and a fencing company to have a 2,500 foot, three-strand barb wire fence installed to restrict vehicle activity and vandalism in non-motorized areas within the site. We are currently working with the adjacent landowner to get approval to install the remaining 500 feet of fence with a steel gate to finish. At our Immigration access site we worked with a neighboring landowner to get property boundaries surveyed and a fence erected to delineate boundaries. Access staff removed woody vegetation and the entire existing fence on the site. We also installed signage and property boundary markers on the site. Unfortunately, due to poor quality of the fence job paid for by the neighbor, access staff has had to reinforce portions of the new fence and will likely have to in the future. Currently we are moving forward with placing a kiosk and better signage directing people to the site for Immigration and Takatori access sites out of Parma.

Currently our Caldwell Ponds site is closed for gravel mining until 2025. Work is being completed to increase the pond's depth and surface area, ultimately increasing the quality of the pond and fishing opportunity. Staff has worked closely on this project to provide appropriate information to the public and monitor progress. Staff also repainted the CXT this year and installed bullet proof glass for the windows. At Red Top Pond, staff delivered and planted 60 mature trees around the perimeter of the pond to provide future shade cover and promote riparian health. We also planted about 15 peach leaf willows at Map Rock. Both Map Rock and Trappers Flat have been high maintenance with vandalism of fences, dumping of materials and pallet burning. Access staff has had to clean up these sites on numerous occasions.

We also completed numerous cooperative projects within the Region's WMA's. In the spring of 2019, access staff created a gravel parking area for the new BRWMA archery course. Another project was the demolition and disposal of an existing 1,600 sqft. house near our Blacks Bridge site on PRWMA property. Access staff also assisted with multiple backhoe digging projects to attain septic information for the development of a new shop. Another cooperative project with the PRWMA access staff was installing 1,000' of steel pole fence and a gate at the birding Island North Site. The gate was vandalized almost immediately and access staff reinstalled it shortly thereafter. We also assisted CJ Strike WMA this year with a parking lot expansion where access staff loaded, hauled and dumped 75 yards of gravel to expand one of the eastern parking areas for WMA access. At Crane Falls Reservoir we rebuilt a cattle guard near the access into Crane Falls/Cove Arm.

In 2019, vandalism was a major issue at our Nampa Sub-region sites. We had 13 large scale dumpings that access crews had to deal with, ranging from a pickup load to a dump truck load of materials. Large dumpings occurred at Indian Creek, Map Rock, Trappers Flat, Blacks Bridge, Immigration and Airport Middleton. Most all dumpings occurred in the Nampa Sub-region. We have also had fences and gates torn out of the ground, shot up outhouse buildings, graffiti, and some equipment thefts in 2019. At a couple problem sites, access staff has placed large boulders restricting access into areas where people historically dump materials (Hwy 52 Access and Blacks Bridge). Site vandalism and dumping has taken allot of unnecessary time and resources that could have been better spent enhancing access sites.

In 2019, staff contributed a considerable amount of time to the design and development of the newly acquired access sites. Our newest acquired site near Emmett is our Sawyers Two (Dick Knox) Pond. Access staff had numerous meetings and has worked with managers, neighboring landowners and volunteers to submit a design for the development of the project. Previously mentioned, staff also contributed to the design and management of two new boat ramp projects in the region (Gem Island and Seven Mile Slough). Another development project set for 2020 is the development of our co-managed Olds Ferry site near Weiser, Idaho. Currently we are working with Idaho Power to design and improve the existing site which will include a new public outhouse and improvements to the boat ramp.

Staff has sought partnerships to increase efficiency, provide better service, and improve management of several access sites. In the Nampa Sub-region our most active partnership is with Canyon County parks and Recreation where we co-manage our Wilson’s Ponds and Martins Landing sites. In 2019, many improvements were made to the Wilson’s Ponds access including garbage can services around the ponds. We are currently looking to install dog waste bag dispensers as an Eagle Scout Project. At Martin’s Landing, we were able to remove five large hazardous trees and assisted with maintenance responsibilities of the campground including restroom service and bi-weekly mowing. In the spring of 2019, we put new batteries in all the overhead solar light fixtures in the campground. Most all improvements were co-funded between IDFG and Canyon County.

Two other strong partnerships are with Gem County and Idaho Power. Gem County provides restroom service for a bulk of our sites in that county. Often we provide a concrete pad and building and the county provides an indefinite service through a local contractor. With Idaho Power we have numerous boat ramps we have installed and either co-manage and/or maintain. We also have this arrangement with some city entities. Our biggest partner for our northern sites is the Treasure Valley YMCA who co-manages the campground functions at Horsethief Reservoir. The YMCA manages most of the functions with the campground hosts, fee collection and has even picked up three additional days per week of the cleaning cost with our restroom contractor. They have also been instrumental with input on the development of those campgrounds.

Another major undertaking this year was with our access site surveys (five year commitment). With the help of numerous IDFG staff, managers and volunteers, we were able to get site surveys completed for all sites in the region. Currently we have been able to create a site Master List for R3 and are uploading a variety of information about the sites and inventorying site needs to better track our projects. Much of this work has been done by an access volunteer who has given a considerable amount of time to helping organize this tracking system and volunteer program.

Lastly we were able to elicit volunteers from the Idaho Master Naturalist to routinely survey sites in the region (quarterly or more frequent). Volunteers report issues with sites to access staff and do light littler pick up of sites. We also gained a few volunteers to help with projects at specific sites in the region and plan to utilize volunteers for more projects in the upcoming season. To date, access volunteers have contributed 278 hours to the access program. We also utilized volunteer Eagle Scouts for projects in the region. This season we had three projects; a site cleanup and trimming day at Wilsons Ponds (57 hours) and are currently building and installing dog waste bag dispensers at Wilson's and a bird dog crossing for Crane Falls.

Other noteworthy accomplishments include work to ensure that department-owned dams were being maintained to Idaho Department of Water Resources standards.

ACKNOWLEDGEMENTS

We have been fortunate to work with several loyal employees that return year after year including Dana Moyer, Tyler Kershner and Nate Campbell. In 2019 we were fortunate to employ the previous Recreation Site Foreman Dennis Hardy to help with the project management of Kings Point. This has been a great help to access staff. We would also like to thank our partners, volunteers and the employees and volunteers of the TVYMCA and SWIDRCD, as well as staff from Canyon and Gem counties.

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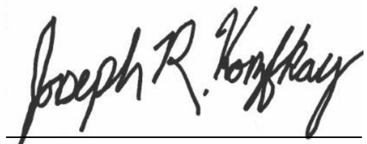

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